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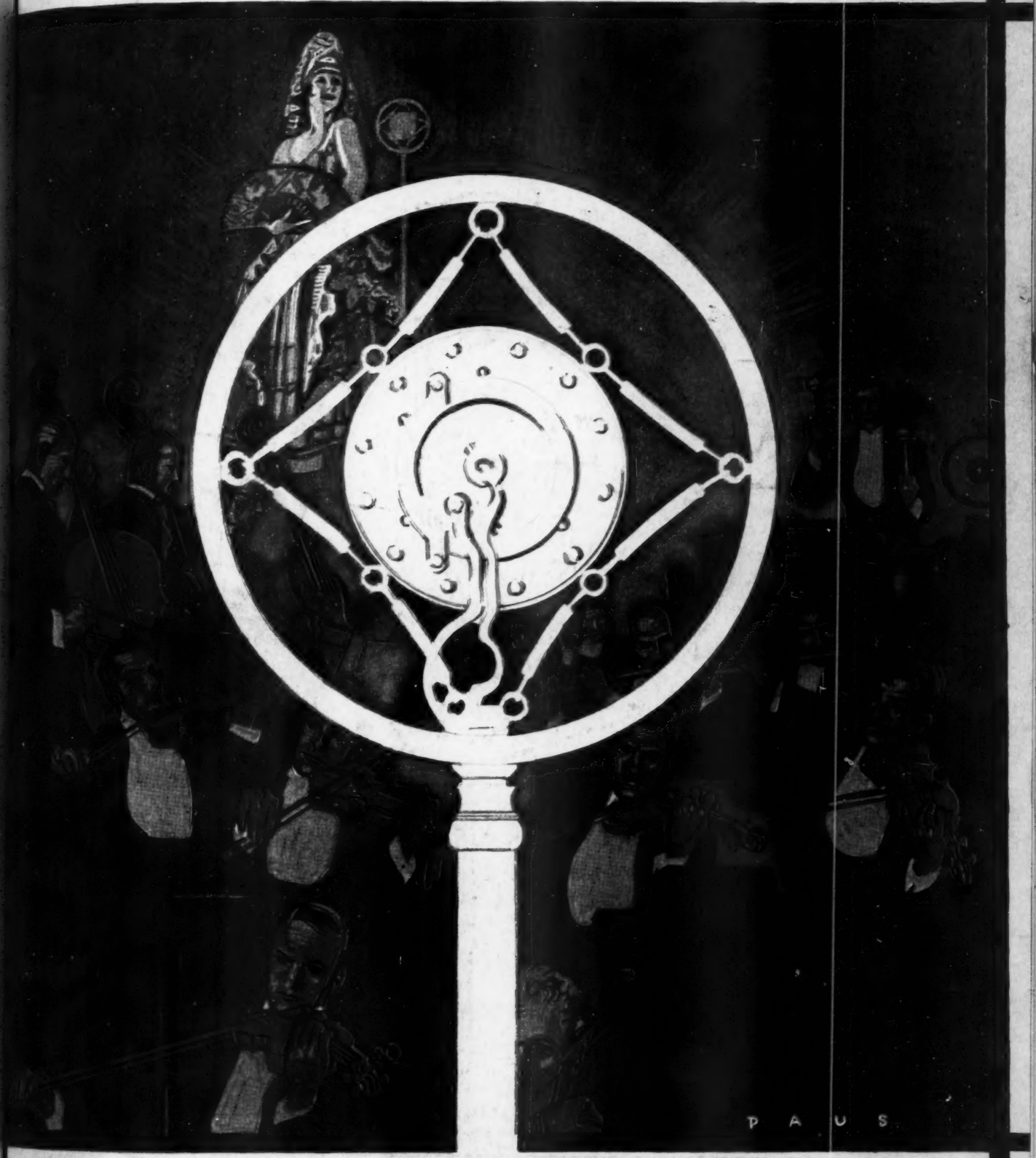

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The *Financial* Adventures of JERRY QUIRK—*A True Story*

By WALLACE AMES, *Financial Editor*

AFTER ten years of hard work and conscientious saving Jerry Quirk had $4,000 in bond and mortgage investments. During those years he had heard many stories of quick profits (on paper) that his friends had made in the bull stock market. Finally Jerry decided to take a flier.

His first venture was ten shares each of two industrials, bought on margin with part of his hard-won savings. Luck seemed to be with him. In just a few days Jerry had 10 points profit in one stock and 3 points in the other. He sold, and after paying interest and broker's commissions he pocketed over $120 net gain—equal to three months of regular savings.

"One good turn deserves another," figured Jerry, so he bought other stocks, this time going in on a little larger scale. Before long, by using profits to extend his operations, Jerry was carrying 200 shares in various companies. In less than four months his paper profits were $2,000.

THEN a red-hot tip came along—something good (?). A certain company was going to declare a big extra dividend. The stock was sure to "go through the roof." Jerry sold all his holdings in order to go into this stock with all that he was worth. But the expected announcement of the extra dividend never came. Instead of going up the heavily touted stock went down. Jerry finally sold with a loss of all his paper profits and over $1,000 of his original savings.

Just a bad break, figured Jerry. He could make it again where he had lost it. So he kept on trading, gaining and losing, waiting for a big chance.

A merger of two companies was rumored—in fact it actually took place. The stock of one of the merger companies had already advanced from 43 to 51 when Jerry got some third-hand information that it would sell at 55 by the next day and go to 60 soon.

Jerry sent in an order to buy. But before his order was received and executed the stock had gone up and he paid 54¾. It actually sold at 55⅞ later the same day, but that was the top. Then it gradually dropped off to around 50 where Jerry sold with a substantial loss.

Some while later a report reached Jerry's ears relating to a pool which was operating in a certain stock. This pool had control of a big quantity of shares and their buying had already caused an advance of several points. Jerry got in around 40. The stock went up without interruption to 56. Then came a recession of a few points and Jerry wanted to sell while he still had a good profit. But his friends advised him to hold.

"THIS decline is caused by just a little profit-taking," they said. "When it's over the stock is due for a 'real' jump." But before the "jump" took place startling news shook the foundations of the already top heavy market and the pool stock went down along with the rest. And Jerry was finally wiped out—all his profits and his original $4,000 gone.

During his several years of speculating Jerry had fine paper profits at times, but most of those profits were lost before he actually realized them in cash.

We have just touched the high spots of Jerry Quirk's speculative adventures which spread over a period of ten or eleven years. If Jerry had kept his original $4,000 invested in sound securities, bearing 6% interest (a rate he could safely get in those days), and had reinvested his interest regularly, today he would have $8,000, not counting anything additional which he might have saved out of salary.

CUMULATIVE investing is in reality a fast way to make money, if you work at it for a period of years. Suppose, for example, you have $5,000 in 5½% bonds and that you can lay aside an additional $1,000 each year out of your earned income. 5½% on $5,000 is $275. Therefore by the end of the first year you should have $6,275. That sum at 5½% yields $345. So, with another $1,000 added from earnings, your investments would show a total of $7,620 after two years. Now let us carry this calculation on for a few more years and see where you would be.

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3rd year	9,039
4th year	10,536
5th year	12,115
6th year	13,781
7th year	15,539
8th year	17,394
9th year	19,351
10th year	21,415

If you want to get ahead *fast* take the *sure* route. *(Continued on page 1)*

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The ANSWER
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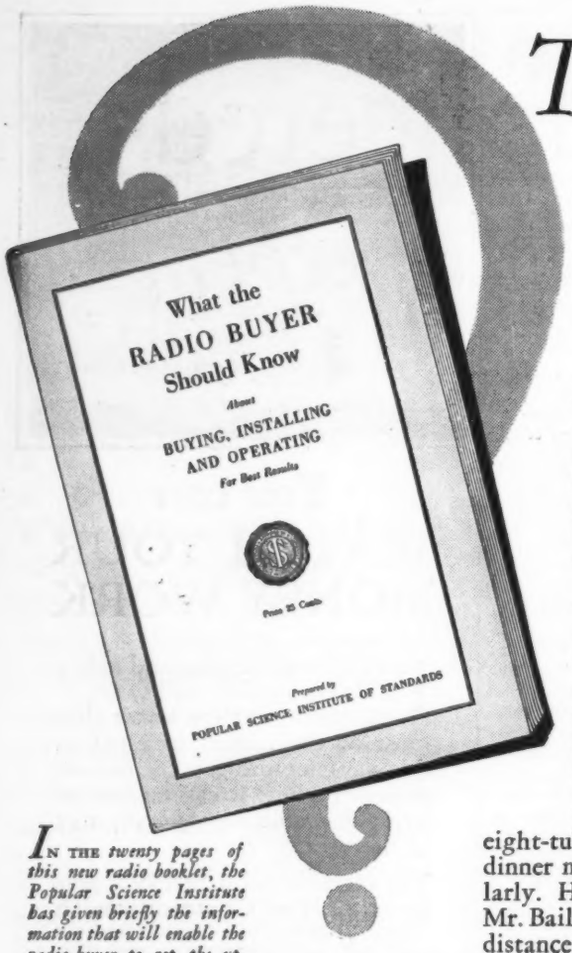

In the twenty pages of this new radio booklet, the Popular Science Institute has given briefly the information that will enable the radio buyer to get the utmost from an investment

IF YOU are one of those people who "don't know the first thing about radio" or a member of the still larger group that know just enough on the subject to realize their inability to get the most out of a radio investment, then you are the type of person that the Popular Science Institute of Standards had in mind in publishing a new booklet called "What the Radio Buyer Should Know."

Every mail for the past several years has brought in scores of letters from POPULAR SCIENCE readers who want to know this, that, or the other thing about radio. And it is not so much the specific questions asked that have given us an idea of what the radio amateur wants and needs to know, as the general lack of information on the subject shown between the lines.

Take, for instance, Mr. Bailey from Iowa, who has a set that brings in Chicago stations but wants to know how much he will have to pay for a radio receiving outfit that will bring in stations all over the country regularly every evening.

In the first place, this reader needs to know just what in the way of performance can be expected from a radio receiving outfit today. Until his requirements become consistent with present-day radio development and he learns the essential factors that enter into the matter, he is going to keep changing sets, spending money, and being generally dissatisfied.

Mr. Bailey cannot understand how a friend of his in a nearby town can bring in New York now and then and other distant stations rather regularly. His friend's set has six tubes while Mr. Bailey has a five-tube outfit. This has given him the idea that a change to a seven or eight-tube set will mean that Cuban dinner music can be counted on regularly. He will be disappointed. After Mr. Bailey learns how location affects distance reception, what type of aerial is best when distance is the quality sought for, as well as the other points that enter into the matter, then there will be both saving and satisfaction in his next investment.

Another letter comes from a man who wants to know how much it costs to run a radio receiver. What he would like is "a fairly cheap outfit that can be operated economically." The chances are that this particular reader owns a very moderately priced car on which he gets ten more miles per gallon than a friend of his who owns an expensive car. He rather naturally figures that the same principle applies to radio and that with an outfit that costs one fourth that of his friend's, he is going to make out with about one eighth of the operating expense the powerful set incurs. This is not the case. There are several ways of reducing operating cost but none of these involve a cut in the initial investment.

THE next letter comes from a Pennsylvania reader who is interested only in tone quality. Since he is willing to do without distance reception, elaborate cabinet and other features, he believes he should be able to do with a very inexpensive outfit. In this point he is mistaken and he is probably going to follow it up with some other errors when he comes to buy his loudspeaker. The perfection of design and high grade parts essential for fine tone quality necessarily bring up the price of a set with the result that one generally must pay more for tone than any other quality.

Figuring that the loudspeaker is what controls the tone principally, this man will very likely be willing to pay a high price for the speaker and economize on the set in order to do so. This will prove a waste of money for the set will not allow him to get full quality results from the loudspeaker. Similarly, a poor loudspeaker with a fine-toned receiver would distort and nullify the set's tone quality.

It is questions like these that the Popular Science Institute of Standards answers in the new radio booklet. Then there is a list given of reliable tested apparatus and an illustrated section on how to install a radio to make it fool-proof as well as efficient. Also, nine pages are devoted to hints on operation such as tuning for selectivity and t o n e, eliminating noises, care of batteries, lengthening the life of tubes and other points that the radio buyer should know. It has been written in nontechnical language that can be understood by the radio beginner. The points covered are, however, ones that are not known by many radio amateurs with fair experience. This booklet can be obtained for 25 cents from the Popular Science Institute, 250 Fourth Avenue, New York City.

Popular Science Monthly
GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY.

THE PUBLISHERS

Balkite has pioneered—
but not at public expense

Balkite "A" *Contains no battery.* The same as Balkite "AB" below, but for the "A" circuit only. Not a battery and charger but a perfected light socket "A" power supply. One of the most remarkable developments in the entire radio field. Price $32.50.

Balkite "B" *Noted for its long life.* The accepted tried and proved light socket "B" power supply. 300,000 units in use show that it is one of the longest lived devices in radio. Three Models: "B"-W, 67-90 volts, $22.50; "B"-135,* 135 volts, $32.50; "B"-180, 180 volts, $39.50. Balkite now costs no more than the ordinary "B" eliminator.

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Standard for "A" batteries. Noiseless. Can be used during reception. Prices drastically reduced. Model "J,"* rates 2.5 and .5 amperes, for both rapid and trickle charging, $17.50. Model "N"* Trickle Charger, rate .5 and .8 amperes, $9.50. Model "K" Trickle Charger, $7.50.

*Special models for 25-40 cycles at slightly higher prices.

Prices are slightly higher West of the Rockies and in Canada.

The great improvements in radio power have been made by Balkite.

First noiseless battery charging. Then successful light socket "B" power. Then trickle charging. And today, most important of all, Balkite "AB," a complete unit containing no battery in any form, supplying both "A" and "B" power directly from the light socket, and operating only while set is in use.

This pioneering has been important. Yet alone it would never have made Balkite one of the best known names in radio. Balkite is today the established leader because of Balkite performance in the hands of its owners. Because with 2,000,000* units in the field Balkite has a record of long life and freedom from trouble seldom equalled in any industry. Because the first Balkite "B," purchased 5 years ago, is still in use and will be for years to come. Because to your radio dealer Balkite is a synonym for quality. Because the electrolytic rectification developed and used by Balkite is so reliable that today it is standard on the signal systems of most American as well as European and Oriental railroads. Because Balkite is permanent equipment. Balkite has pioneered — but not at the expense of the public.

Today, whatever type of set you own, whatever type of power equipment you want, whatever you want to pay for it, Balkite has it. And production is so enormous that prices are astonishingly low.

Your dealer will recommend the Balkite equipment you need for your set.

BALKITE "AB"

Contains no battery. A complete unit, replacing both "A" and "B" batteries and supplying "A" and "B" current directly from the light socket. Contains no battery in any form. Operates only while the set is in use. Two models: "AB" 6-135,* 135 volts "B" current, $59.50: "AB" 6-180, 180 volts, $67.50.

FANSTEEL PRODUCTS COMPANY, Inc., *North Chicago, Illinois*

FANSTEEL

Balkite

Radio Power Units

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6

Grebe Natural Speaker $35

Grebe Synchrophase Seven $135

A Great Set— a Wonderful Speaker

What is good reception?

Hear this Grebe combination! In no other way can you gain adequate conception of what radio should be—full, true, absolutely natural in tone, without discordant note.

Space does not permit explanation of the new Grebe developments which make possible such remarkable performance.

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If you do not at once hear the Synchrophase Seven your loss cannot be estimated.

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Popular Science MONTHLY

FOUNDED 1872 — FIFTY-SIXTH YEAR

OCTOBER, 1927 — SUMNER N. BLOSSOM *Editor* — VOL. 111, NO. 4

Commander Richard E. Byrd (left) famous Polar and trans-Atlantic flyer, answering the questions of Roy Guffin (right), explains the many opportunities in aviation for the ambitious young man. Mr. Guffin, twenty-four years old, is a shipping clerk of Brooklyn, N.Y.

Commander BYRD Tells Roy Guffin
How to Get into Aviation

Young men are sending letters by the thousands to this magazine, asking for information as to opportunities in aviation, how to get into it, and what it holds for them. To afford every one the advantage of expert advice from high authority, POPULAR SCIENCE MONTHLY arranged with Commander Richard E. Byrd, U.S.N., famous North Pole and trans-Atlantic flyer, to answer the questions of one typical young man with an inclination toward aviation, Mr. Roy Guffin. The record of their conversation is presented here in the belief that Mr. Guffin's questions embody what you would have asked Commander Byrd had you had the opportunity. Whether or not you plan to go into aviation, you are sure to be interested in the unusual opinions expressed on these pages.

MR. GUFFIN: As I am thinking of aviation as a career, Commander Byrd, won't you tell me what you think of the opportunities for a young man going into this field? Are there many openings now? And are there likely to be more openings in the future?

Commander BYRD: Yes, there are all sorts of opportunities. I think there's a fine future today for young aviators, especially in commercial aviation. That's what you have in mind, I suppose.

Mr. GUFFIN: What about the Army and Navy and the Marine Corps? Is the Government still looking for flying men?

Commander BYRD: If you want to fly a military plane you must be an officer of the Army, Navy, Marine Corps, National Guard, Army Air Reserve or Navy Air Reserve. The Government is always out for good men.

Mr. GUFFIN: How could I get into the Air Reserve?

Commander BYRD: That is recruited usually from former officers of the Army, Navy or Marine Corps, graduates of the Officers Reserve Training Corps, or college graduates. But the Reserve doesn't give you a career, although you would be called into service in war-time. The Government would teach you to fly, but you'd have to earn your own living some other way.

Mr. GUFFIN: I couldn't get in, anyway. I'm not a college graduate.

Commander BYRD: Then your only chance to get into military aviation is to enlist in the Army, the Navy or the Marine Corps, and get assigned to flying service. If you make good you can get the highest possible rating and pay for an enlisted man, but you won't be allowed to pilot a plane. Your job would be to take care of planes on the ground or afloat, repairing, rigging, overhauling

Once a flyer has become an expert pilot, he can earn considerable fees as a sky writer of advertisements or in giving exhibition flights

engines to keep them in perfect condition, and so on. It takes a lot more men on the ground, to each plane, than it does to fly them; in the French army there are twenty ground men to every pilot. Of course, every enlisted man has a chance to study for a commission, but to get promoted to officer's rank, he must have a first-rate education.

Mr. GUFFIN: I guess that lets me out as a military aviator. What about commercial aviation? Aren't there plenty of good pilots now for all the planes in commercial service?

Commander BYRD: No, I don't think so. It's true there are lots of men who learned to fly during the war; but remember that the youngest of these would now be nearly thirty, and their places must always be taken by younger flyers coming along. The best of them soon drop out of actual flying into other branches of commercial aviation, such as operating air services of different sorts, designing and building planes, building up business for air transportation companies, and so on. Then there are many who know how to fly a plane, but can't meet all the requirements for a Government pilot's license, under the new laws for commercial aviation. And besides, the number of commercial planes is beginning to increase very rapidly and will keep on increasing, I think. It will be a long time, I believe, before there will be enough first-rate pilots to supply the demand.

Mr. GUFFIN: Does a man have to be a licensed pilot to take advantage of the other opportunities in aviation of which you spoke?

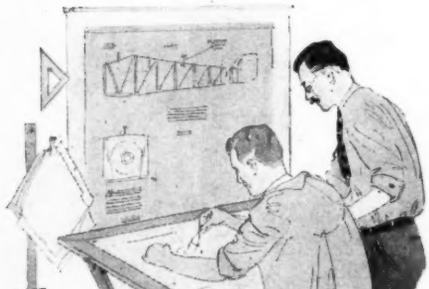
Commander BYRD: It's not absolutely necessary, but desirable. Certainly the man who knows how to fly a plane has experience which is valuable if he finally finds his best opportunity in designing or building planes or engines or accessories, or in the many other lines of "ground flying."

Mr. GUFFIN: What about the expert pilot who can get the highest grade of license? Can he make a living at flying alone?

Commander BYRD: A great many do. Air Mail pilots are paid from $6,000 to $8,000 a year. Other kinds of commercial air work, such as carrying express matter and passengers, either on regular routes or in so-called "taxi" service, pay the pilot anywhere from $3,000 to $4,500 a year, I believe.. All these kinds of commercial services are growing rapidly. So are aerial photography, aerial surveying, and the use of airplanes for spraying or dusting crops to kill off insect pests.

Mr. GUFFIN: Isn't there often a chance for a flying expert to win big prizes, like the $25,000 Lindbergh got for crossing the Atlantic?

Commander BYRD: I wouldn't say that. Yet when a flyer has made a reputation he can often get a good fee for giving exhibition flights. Then there are air races of various kinds, with cash prizes. The plane has as much to do with winning one of these prizes as the pilot's skill, so the pilot and the builder or owner of the plane often split the money.



Aeronautical engineers are in great demand. Ideas for plane construction may lead to a position as engineering head of some big firm

Mr. GUFFIN: If I went in for flying, would it cancel my life insurance?

Commander BYRD: I think you'd have to have a special clause written into your life and accident policies, permitting you to fly, under certain restrictions. But I believe several insurance companies write aviation accident insurance, at a premium rate not much higher than for ocean travel.

Mr. GUFFIN: Then my chance of being killed in an airplane, if I become a pilot, is not much, if any, greater than traveling on a train or ship, or driving an auto?

Commander BYRD: I can't say as to that. I believe there are no accurate statistics on the subject. But did you know that the Air Mail pilots last year flew more than four million miles with only one fatal accident? On the other hand, there have been a lot of deaths due to incompetent pilots, old or structurally weak planes, sudden storms and taking unnecessary chances. It all depends on your plane and yourself and the conditions under which you fly.

Mr. GUFFIN: Some of my friends say that a flying man has no right to get married and have a family, but ought to avoid such obligations. What do you think about it?

Commander BYRD: Well, for the man who always believes in "safety first" as the most important rule of life, there's something in that point. That kind of man will never amount to much as a flyer—or anything else for that matter. There's no doubt, though, that flying is getting safer every day, now that the Government is requiring rigid inspection of both planes and pilots.

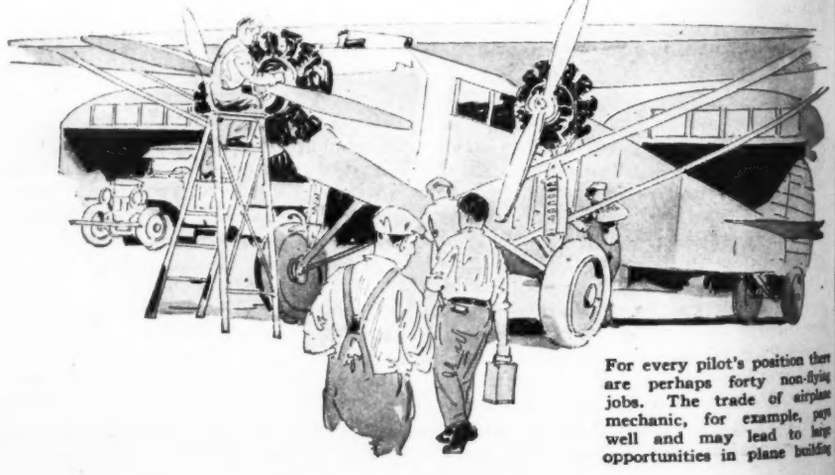
Mr. GUFFIN: If I decide to try to become a pilot, will it be better for me to go into an airplane factory and learn all about planes, first, or should I enter some aviation school?

Commander BYRD: Both ways are feasible. The more a pilot knows about the way planes are built, the better. I'd say that if you have to earn your living as you go along, the better way to begin would be to get a job in an aircraft factory and watch for your opportunity to get a chance to fly occasionally. You'll get into the air more quickly, of course, by going to an aviation school; and in any of the good schools you'll have to learn a great deal about the construction of the plane, as part of the course.

Mr. GUFFIN: How many good aviation schools are there at present in the United States?

Commander BYRD: I believe there are nearly a hundred organized schools, and a great number of individual pilots, owning their own planes, who give instruction, besides. I wouldn't undertake to say which are the best.

Mr. GUFFIN: What previous education is needed to get into an aviation school?



For every pilot's position there are perhaps forty non-flying jobs. The trade of airplane mechanic, for example, pays well and may lead to large opportunities in plane building

Commander BYRD: I don't think there are any rigid standards. It's a matter of general intelligence rather than formal education. The more you have of both, the better, of course; but I believe most young men who go in for flying have the equivalent of a high school education, though the percentage of college men is increasing.

Mr. GUFFIN: Will I have to take a physical examination to enter a flying school?

Commander BYRD: I don't know of any school which requires more than a sound and healthy body. Before you could get a Government flying license, however, you'd have to pass a rigid examination, especially of your vision. If you have any doubt about your physical qualifications it would be well to send to the Department of Commerce at Washington for a copy of the regulations regarding air pilots' licenses and have your own physician go over you before you begin.

Mr. GUFFIN: How much will it cost me to become a competent pilot, if I go to an aviation school?

Commander BYRD: The fees vary. One school charges three hundred dollars for its course, which is unusually complete. In addition, you'll have your living expenses to meet. After graduation, unless you can immediately get a job that calls for some flying, you'll have the additional expense of renting a plane to fly the number of hours which are required for a commercial license.

Mr. GUFFIN: How long will it take me to finish the course, in a good school of aviation?

Commander BYRD: That will depend upon your personal aptitude for flying. Some get through in thirty minutes. It doesn't take longer than that, after a man is in the air, to tell whether he'll ever make a pilot. But if you aren't dismissed as hopeless after the first half-hour of flying, you can finish the school course in four or five weeks.

Mr. GUFFIN: Can I actually learn to fly in that time?

Commander BYRD: Yes and no. If you have any flying instinct at all—if, for example, you are able now to handle an automobile in traffic safely—you should be able to fly alone after only three to five hours in the air. But what you'll get at any aviation school will be only the beginning of what you'll have to learn to classify as a licensed pilot—unless you are exceptionally apt.

Mr. GUFFIN: Just what do I have to learn, and how will they teach me?

Commander BYRD: Besides the rudiments of navigation, aerodynamics and airplane construction, you must learn how to handle your plane in the air under a variety of conditions. Training planes are equipped with dual controls, the instructor sitting in the forward cockpit and the pupil in the after cockpit. The pupil has the same controls as the instructor, connected so that when the instructor moves the control stick or the rudder bar those in the student cockpit move in the same way. In that way the student learns what happens when certain things are done, and as soon as he has become familiar with the controls the instructor lets him do the steering. Usually the student doesn't know that he is doing it until it is all over, the first time he handles the plane alone.

Mr. GUFFIN: What is the hardest thing to learn in an elementary course like that?

Commander BYRD: Landing. Handling a plane in the air is simple. With modern planes, it is as easy as driving a car, in good flying weather, and safer. Getting off the ground requires practice, but making a good landing is the most difficult part of the whole course of instruction. The reason is that it requires an entirely new use of your judgment of distances and speeds.

Mr. GUFFIN: What is the most serious accident that can happen to a student in the air?

Commander BYRD: Stalling, or losing flying speed, so that the plane doesn't respond to its controls.

Mr. GUFFIN: What causes that?

Commander BYRD: Trying to climb too steeply with a low-powered engine, as a rule.

Mr. GUFFIN: What happens then?

Commander BYRD: If you are too near the ground to give the plane a chance to regain flying speed by a dive or other maneuver, you crash.

Mr. GUFFIN: How many hours of solo flying does the student in one of these schools get?

Commander BYRD: Ten hours, I believe, is customary. It is given in fifteen-minute doses, so that means forty actual flights.

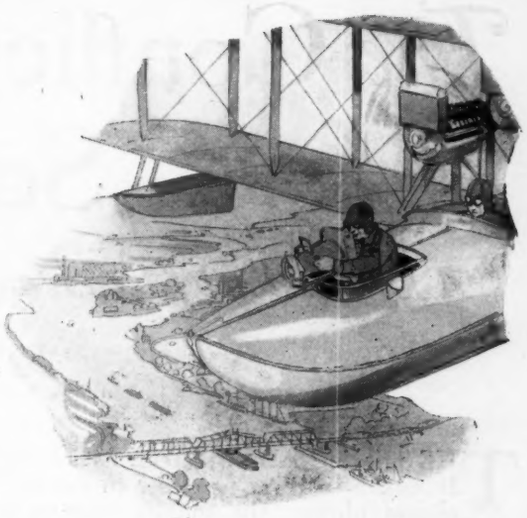
Mr. GUFFIN: Could I shorten my course or learn to fly more rapidly by taking a course in one of the correspondence schools which teach the theory of aviation?

Commander BYRD: No doubt such a course, if well prepared, would help you master the underlying principles, and it ought also to help you pass the theoretical examination required for obtaining a pilot's license.

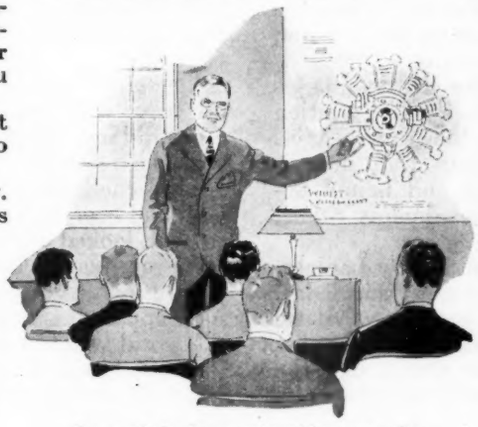
Mr. GUFFIN: But after I get my diploma from the flying school, I won't be allowed to fly anywhere else, will I, without more training?

Commander BYRD: You'll get a student's license on entering the school, but that won't permit you to take up a licensed plane except with an instructor in control. Then you can get a private license, which will permit you to fly over a limited area, but not to carry persons or property for pay. To earn money as a pilot you need either a limited commercial license, an industrial license, or a transport pilot license.

Mr. GUFFIN: How many hours of flying must I do before I can get such a license? (*Continued on page 158*)



Aerial photography offers an excellent future, says Commander Byrd, especially in the field of aerial surveying and map making



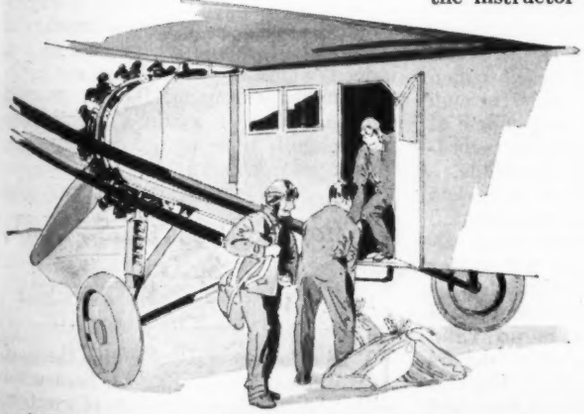
Some of the large universities now offer thorough courses in airplane engineering

What Would You Ask?

IF YOU, like Roy Guffin, should have an opportunity to talk with Commander Byrd about a career in aviation, what questions would *you* ask him? After reading the interview on these pages, are there still some points you would like to have explained?

If so, we shall be glad to supply information in reply to any reasonable query.

Address your communications to the Aviation Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City, inclosing a self-addressed stamped envelope.



Air Mail pilots earn $6,000 to $8,000 a year. Sometimes a flyer who owns his plane may pick up a profitable short-line mail contract

The Conflict Between Science *and* Religion

A Discussion by Leaders in American Life, with an Introduction

By BRUCE BARTON

Author of "The Man Nobody Knows" and "The Book Nobody Knows"

THE printing of these statements is a public service. It ought to bring us closer to the day when the absurd phrase "the conflict between science and religion" will be permanently in the discard.

When theologians presume to prescribe the boundaries of truth they put themselves in the impossible position of most of their predecessors through the Middle Ages.

When scientists presume to announce that man is merely material, coming from nothing and bound nowhere, and that the universe is a meaningless riddle, they are equally out of their depth.

The real scientific spirit was exemplified by Laplace, who, having devoted his life to finding new knowledge, died exclaiming: "What we know is nothing, what we do not know is immense." And the real religious spirit is Kant's, who looks at the firmament above, and the moral nature within, and bows his head in reverent awe.

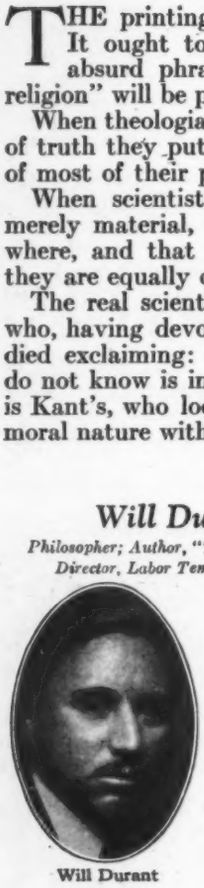
Jesus had no conflict with scientists. His conflict was with theologians who by their usurpation and their formalism shut people off from direct intercourse with God.

The great battles which have divided the church have all been over matters He regarded as unimportant. Jesus did not stand at the door and challenge all comers with the question: "Do you believe in the Virgin birth?" He did challenge those who assumed to know all about God and everything else, and who, in their self-righteous conceit, looked down on God's sons and daughters.

He represented God as Love and Wisdom. Little by little we are rediscovering Him. And with each step it becomes more apparent that most of the fights that have embittered the world were futile. And that life has possibilities of comradeship and mutual understanding and happiness which He saw more clearly than any one who has ever lived.

Will Durant, Ph.D.

Philosopher; Author, "The Story of Philosophy"; Director, Labor Temple School, New York



Will Durant

GOD, to me, is the creative power operating continuously in all the processes of growth. Religion is reverence for, and coöperation with, all the forces of growth, within ourselves and without. Science, if it takes its lead from physics, is in irreconcilable conflict with religion; but if science takes its lead from biology (as it may in our century) and recognizes that the processes of life reveal the inner nature of the world more nearly than the mechanisms of matter, it may be possible to reconcile science with a sane, *natural* religion.

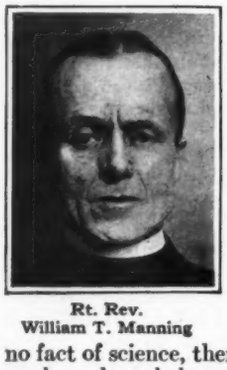
As to harmonizing the theory of evolution with the Biblical account of creation I do not believe it can be done, and I do not see why it should. The story of Genesis is beautiful, and profoundly significant as symbolism; but there is no good reason to torture it into conformity with modern theory.

Rt. Rev. William T. Manning, D.D., S.T.D., D.C.L., LL.D.

Protestant Episcopal Bishop of New York

GOD is truth, and if we are to be faithful to Him we must place loyalty to the truth first and above all else. We must be ready to accept, and rejoice in, the truth from whatever source it may come. There can be no real conflict between the truth made known to us by science and the truth revealed in Christ, and today it is clear that there is no conflict. The supposed antagonism between religion and science is out of date, and belongs to a day that has passed. We see the greatest scientists accepting, as Lord Kelvin did, the truth of the Christian Religion, and we see the greatest Christian scholars, men who believe the Christian Faith in its fullness, accepting with their whole hearts and minds every fact that science has established.

There is nothing in the Christian Faith which conflicts with the scientific theory of evolution. On the contrary, this hypothesis seems to make clearer the glory and power of God the Creator of all, and it harmonizes with God's method of revealing Himself to men gradually, through the long course of history, as recorded in the Bible.



Rt. Rev. William T. Manning

For my own part I can say, and I know many scientists will say as I do, that there is no fact of science, there is no discovery of modern knowledge, there is no valid claim of truth or reason, which debars any sincere man or woman from full and humble faith in Jesus Christ as God and Saviour.

Willis R. Whitney, Ph.D., Ch.D.

Chemist; Director, Research Laboratory, General Electric Company

MAN has apparently only just begun to know and to appreciate. He is so near his origin that the records of his earliest efforts are still visible. If he may judge from his relatively brief past, he will continue indefinitely in a growing understanding, appreciation and utilization of the infinite creation. If anything is clear, it is that evolution, which in man seems but started, cannot conflict with religion, though it may increase wonder and reverence. It would seem a poor religion, indeed, which depended upon our feeble, continually changing, though growing, science, or which made a scientist any more eligible than a child for any blessings it provides.

Willis R. Whitney

Vernon Kellogg, M.S., LL.D., Sc.D.

Zoölogist; Author, Permanent Secretary, National Research Council, Washington, D. C.

IT IS asked how the scientific theory of world evolution may be harmonized with the Biblical account of creation. It may well first be asked how the account

Vernon Kellogg

of creation in the first chapter of Genesis can be harmonized with the account in the second chapter. The answer in both cases is that neither of these Biblical accounts is to be looked on as a literal description of world creation. They are both great poetic pictures and should be so viewed by scientist and religionist alike.

The harmony between the Biblical and the evolutionary account of the creation of universe, world and animate Nature is the harmony between great poetry and great science. If another sort of comparison is made; that is, if the Biblical account is to be looked on as a literal and scientific account, to be compared with the scientific account given by the astronomers, geologists and biologists, then, and then only, is there disharmony. And as between the disharmonious two, the scientific account by the scientific man has all the weight of evidence in its favor.

One can believe in the Bible but not accept it for something it was not intended to be. The Bible contains the greatest basis we know for human philosophy and human behavior. But it is not a scientific manual of astronomy, geology and physics, and it should not be degraded from its high estate by making it pretend to be such a manual. Scientific men are kinder to the Bible than are its literalistic upholders. They accept it as a book greater than any scientific book. They do not want it to be looked on as anything less than that.

James J. Davis

U. S. Secretary of Labor

IN MY opinion, there is no conflict between science and religion. I firmly believe that in the heart of every scientist, the deeper he delves into the mysteries of this world, the more respect and admiration he has for the God who created it.

James J. Davis

There is a point in religion and in science beyond which mere man cannot go without meeting the Unknowable, the creative source of all things. Beyond that point man must accept some things on faith, and there are just as many things to be accepted on faith in science as there are in religion. We know that the invention of the microscope alone sent a number of previously accepted scientific theories into the discard.

Many other discoveries and inventions have from time to time compelled the revision of the scientific attitude regarding various phases of the physical world.

The theory of evolution is just another scientific theory, an hypothesis, an attempt to draw a logical conclusion from a careful tabulation of the large mass of data on hand. Science might trace everything down to a single living cell, but where did this cell come from and what gives it this mysterious force we call life? Science has one explanation for the origin of life, religion another, and no man is wise enough to say that one explanation is right and the other wrong. Religion is man's expression of reverence for the Creator, but science is interested only in observation, experiment, and the discovery of the laws that govern the universe. The Bible tells things in poetry; science puts them into cold, hard figures and laws. One appeals to the heart, the other to the head; and, according to one of our ablest scientists, religion begins where science leaves off. I repeat, in my judgment, there can be no conflict between the two.

Rev. Stephen S. Wise, Ph.D., LL.D.

Rabbi, Free Synagogue, New York

THE Biblical account of creation does not purport to be a scientific statement; for one reason, because there was no such thing as the possibility of scientific statement when the Biblical account of creation was written; in the next place, because the Biblical account of creation, whatever its origin, is a poetic interpretation, not a statement of scientific investigation. I have sometimes put it that evolution deals with beginnings and the Biblical account of creation points to the divine destiny of humankind.

Rev. Stephen S. Wise

Science no more invalidates religion than religion invalidates science. Religion does not pretend to give a scientific account of the origin of things. Religion is mystic and science is obvious, but the truth of the fact is that much of the spirit of mysticism has come into the farther outreachings of the scientific explorer. One pities those lovers of the Bible who degrade it rather than exalt it by setting up the mytho-poetic tales of three thousand years ago and more in opposition to the hypothesis of the new science of our day. But it is little less pitiable to note the scoffing attitude of some scientists with regard to religion.

Commodore Herbert Hartley

Commander, S. S. Leviathan

THERE is no conflict between science and religion. The trouble, if any, lies at the foundation of hasty conclusions of prejudiced or biased minds.

Evolution as a theory can certainly be harmonized with the Biblical account of creation. They travel in separate and parallel grooves. The creation of life is a single and distinct achievement. The development and evolution of life is another.

I believe it more reasonable to conclude man was created by a slow process of evolution than that he was made instanter. If we accept the theory of evolution we do not by that acceptance reject the Biblical account of creation. No scientist has yet dared to deny the one great account of the origin of life. They only attempt to trace it on through the ages.

Com. Herbert Hartley

Heber D. Curtis, Ph.D.

Astronomer; Director, Allegheny Observatory, Pittsburgh, Pa.

THE Book of Genesis omits all explicit reference to radio, popular government, the steam engine, or evolution. I have always regarded attempts to "reconcile" such omissions or differences as not only unscientific but, in a sense, irreligious, nor can I admit any "conflict" between modern science and true religion, in its higher sense.

In poetic form and with oriental imagery, the Hebrew sage told his story of creation; the simplicity of his measured and dignified picture sometimes blinds us to the essential fact that it was he who first clearly saw the one Power behind it all, and that this is the measure of his inspiration, rather than the precision of his picture.

The modern scientist differs from the poet of three millennia ago simply in that he sees more steps of the creative progression. While scientists still differ as to the importance or validity of this or that minor process, there is in this world today no scientist of standing who rejects the essential and larger aspects of that creative method called evolution which has been used in everything from starfish to star-cluster. Scientific study leads us inevitably to a wider, more wonderful and more awe-inspiring comprehension of the universe; nor can such study, if it be rightly regarded, diminish any belief in God or the teachings of the Nazarene.

Heber D. Curtis

Could one formulate the creed of a reverent scientist (and their number is legion, despite the assertions of evangelistic "exhorters,") it would perhaps read: "I believe that God created, *and is still creating,* the heavens and the earth and all that in them is, by the process of evolution."

Dr. Frank Crane

Clergyman, Journalist, Author

THERE never has been trouble between the religious feeling and the scientific mind. The difficulty has been between the scientific method and the church.

Religion is simply a man's attitude toward the always present unknown.

We continually explore the unknown; but the

(*Continued on page 162*)

Airman Plunges Seven Miles in Blazing Plane

Champion Regains Lost Senses and Lands Safely by Miracle

By L. G. POPE

Lieut. Champion being dressed for altitude flight that ended in fiery plunge to earth

FOR about forty minutes Lieut. Carleton C. Champion, crack Navy flyer, had been spiraling upward in his Wright Apache plane above the Naval air field at Anacostia, D. C., bound for a new world's altitude record. He was breathing oxygen, now, to keep himself conscious. The altimeter, that indicates a plane's height above the earth, claimed his attention. "Forty-seven thousand feet," it said.

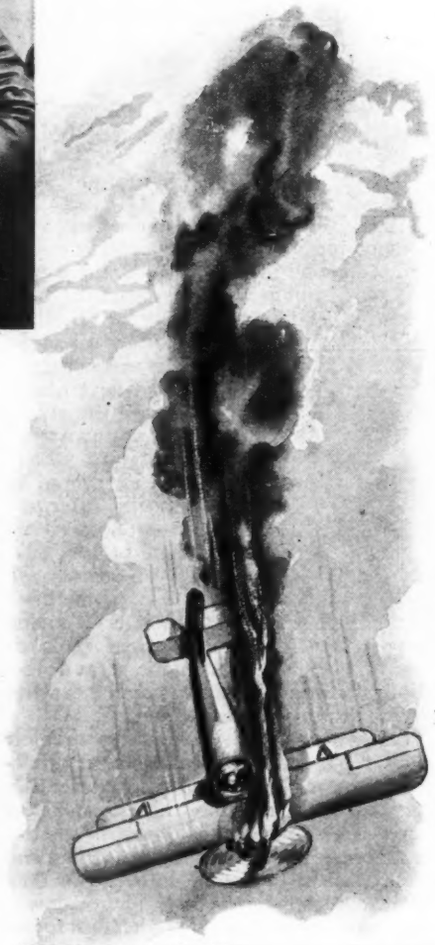
Nine miles up! Higher than man had ever gone before. Higher than Callizo, the French aviator who flew his biplane to 40,820 feet. Higher even than Capt. Gray, the Army aeronaut who reached 42,470 feet in a free balloon!

Why was the plane vibrating so? The engine was going to pieces! Tremors shook the frail craft. Then everything went black—a flying cylinder head had ripped the life-giving oxygen tube from Champion's mouth. Dimly he saw it, hanging from the instrument board. He was falling, he knew. He must have oxygen. With an effort he seized the tube, replaced it in his lips.

FIRE! He was wide awake now. Terrific vibrations shook the plane. Part of the engine was gone, and flames were shooting from the remainder. The propeller was useless—it had stopped long ago. Into a sideslip Champion steered the machine. The skilful maneuver extinguished the flames, but only for a moment. Now a dive and again they were conquered. A third time they started, and once more a sideslip blew them out. Now Champion straightened out his plane to head for the landing field. Then the whole front of the craft took fire.

Champion could have seized his parachute and jumped; but he didn't. That would have meant leaving behind the precious recording instruments by which his altitude must be officially verified.

They saw him from the flying field below—saw him falling, tail first, his engine in flames and his plane trailing white smoke, at a height of ten thousand feet. An ambulance raced to the spot, ready to dash with him to a hospital if he still lived after the inevitable crash of a crazily falling plane with a dead motor.



Then a miracle happened—Champion righted his plane. Fire out, it slipped forward, straightened, swooped to earth in a cornfield. Onlookers rushed toward it. Out stepped Champion without a scratch, clutching a recording barometer.

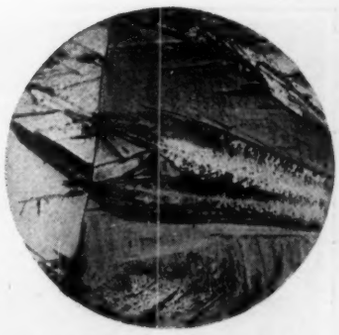
This was the sensational flight that thrilled the world of aviation the other day. True, luck was against the lieutenant. All his skill—including his intentional stunt of falling backwards, to keep the flames away from the instruments—had failed to save one of the barometers—completely destroyed by a flying piece of the engine. The other instrument, only slightly jarred, had recorded a maximum altitude of not more than 39,000 feet, Bureau of Standards experts said after preliminary tests.

Not an official world's record after all—for Callizo and Captain Gray made better marks than this, as shown in last month's POPULAR SCIENCE MONTHLY. But there is little doubt that Champion's sensational flight established one record—that of the longest fall in history. He had plunged downward nearly seven miles, eclipsing the six-mile plunge of Major R. W. Schroeder on a similar occasion.

Lieut. Champion received by fellow flyers after landing burning plane safely at end of seven-mile drop. Above: A drawing of the fall that terminated ill-fated attempt at an altitude record

Lead sheath of telephone cable, hardened with antimony (white streaks), magnified 2450 times

One Millionth of *an* Inch Photographed!



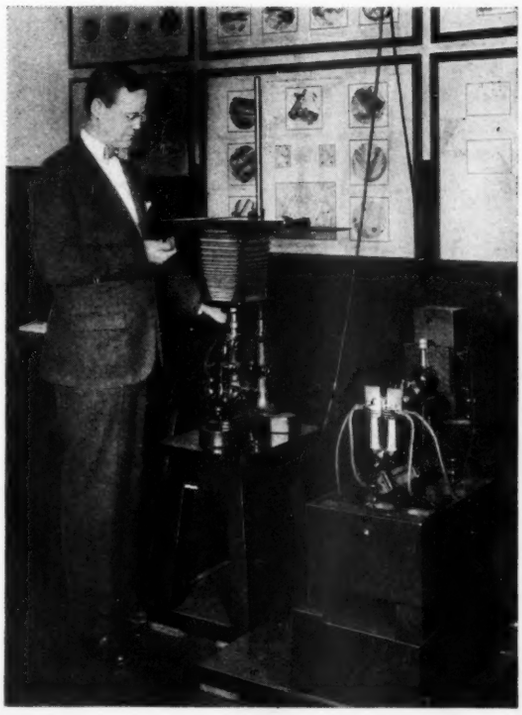
A startlingly clear photograph of a speck of steel magnified 6000 diameters, showing woodlike grain

Wonderful Microscopic Cameras Reveal "Insides" of Metals; X-Rays Take Pictures of Molecules!

IN A New York laboratory, pictures of bits of iron and steel, magnified 6000 times, are being taken, distinct and clear! Under the lenses of high power microscope-cameras, other metals, paper, and rubber are revealing their innermost secrets—what makes them hard or soft; why they are flexible, brittle, elastic, or ductile.

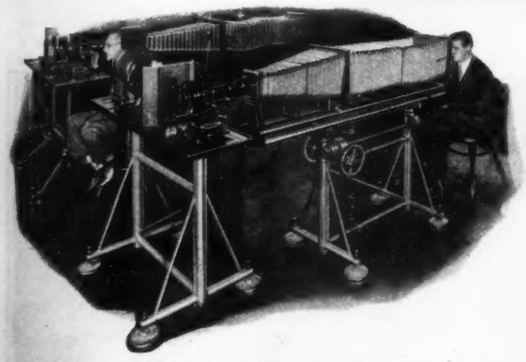
How to improve the thousand-and-one materials used to make telephone apparatus is the question that Francis F. Lucas and his staff of experts in the Bell Telephone Laboratories are seeking to answer, aided by the most highly magnified and clearest photographs ever taken. Through their studies it may be possible, for instance, to make an important machine bearing more resistant to wear, or to improve a spring that must be flexed millions of times without breaking.

Microscopic-sized crystals in metal determine how it behaves. They are revealed with such clearness in the new pictures that it becomes easy to tell what may be expected of a large piece of metal like the tiny sample examined.



Francis F. Lucas of the Bell Telephone Laboratories making an ultra-violet photomicrograph of metal. Ultra-violet rays, made by a spark between cadmium metal points in the apparatus at right, pass to the microscope camera

At left: An expert operating one of the high-power microscope cameras



The discoveries may lead to improved ways of making steel. When molten steel cools in the making, mysterious things happen. Odd compounds of the iron and carbon ingredients may form. "Ferrite," "martensite," and "pearlite," as some of these are called, may collect in dangerous weak streaks between the minute layers of steel crystals. Samples of these steels, magnified thousands of times, clearly showed the treacherous streaks, and experts found that certain methods of heat treatment reduced the formations. Now they are applying this knowledge to steel manufacture.

Previously, the highest magnified photographs published were of about 1500 diameters—that is, a line an inch long on the picture represented a line 1-1500 of an inch long on the original object. With the same microscopes, Lucas and his assistants now are making clear-cut photographs magnified 5000 to 6000 diameters!

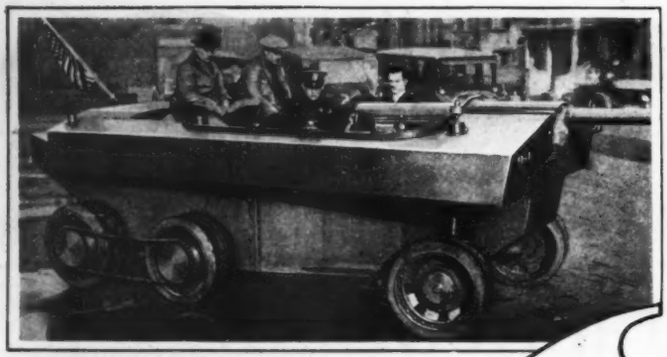
Extraordinary care in etching specimens with acids to bring out their structure, and almost superhuman precision in focusing the microscope, make this possible.

The tiny dots of metal enlarged for the two pictures at the top of this page, plus a few thousand similar dots, would fit comfortably in the period at the end of this sentence. A pinhead, magnified on the same scale, would measure fifty feet across. Yet it is the startling clearness of the pictures, rather than their magnification, that makes them of inestimable value. Fifteen "millimicrons"—about one-millionth of an inch—is the size of the smallest speck you can distinguish on them—1-130 the size of a typhoid germ!

Molecules themselves, the tiny building blocks of the universe, are only about a hundred times smaller than the smallest things shown by the microscopes, using visible light. New methods are being tried at the Bell Laboratories which, it is hoped, will permit a closer approach to the molecule itself. Now they are experimenting with an instrument of still unexhausted possibilities—the ultra-violet microscope.

With the ultra-violet's short wave length they are taking photographs of amazing clearness. Eight small pictures are taken, with the position of the microscope altered for each. Between the points at which the two clearest photographs were taken, eight more are made. Repeated trials at last obtain a perfect focus—the microscope adjusted with the accuracy of about one thousandth of a literal hairbreadth. Now the final photograph can be taken.

X-rays, too, are being tried out for studying the "insides" of matter. Too short to be focused by microscope lenses, these invisible waves, more than a thousand times shorter than the ultra-violet, are revealing, by means of an instrument known as the "X-ray spectrograph," individual molecules—not to the eye, but to the camera. Curious lines on the resulting photographs enable experts to "reconstruct" the molecule's picture.

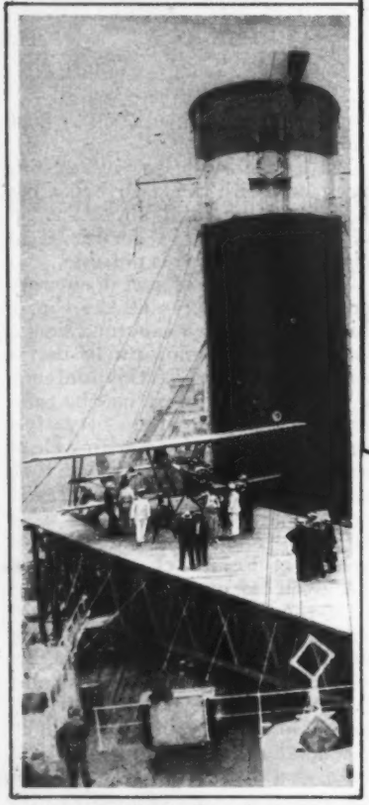


On land and sea the new war tank invented by Walter Christie is at home and, with its guns, equally deadly. Above, it is shown on land and, at right, crossing the Hudson after climbing the Palisades

The thrillingest thriller in Italy is the feat of Ugo Zacchini, who is shown below being shot from a cannon to land in a net 150 feet away. Some say a spring shoots him out, the blast being a trick

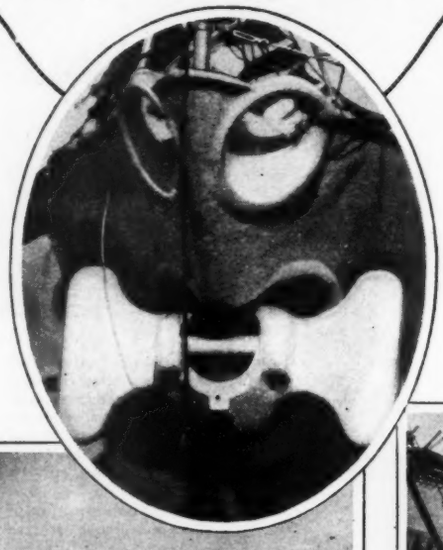
New Marvels *to Open* Your Eyes

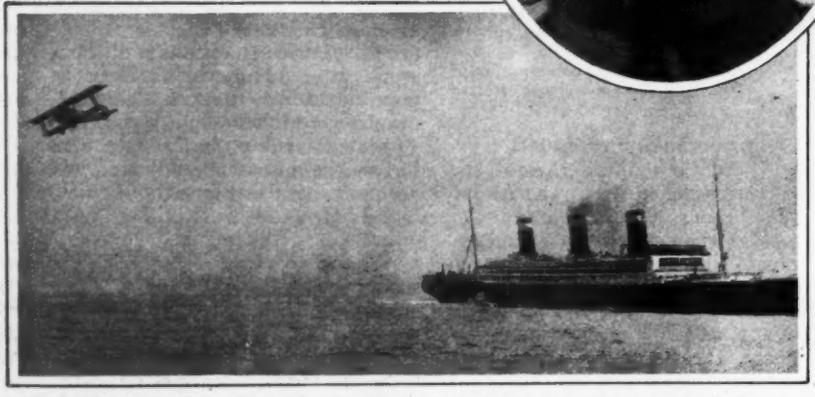
Man Shot from Gun; Boat Fast as Plane; Seagoing War Tank



Clarence Chamberlin, first trans-Atlantic flyer to Germany, recently hopped in this plane from the specially built runway on the U. S. S. *Leviathan*, while 82 miles at sea, for the purpose of landing mail in New Jersey

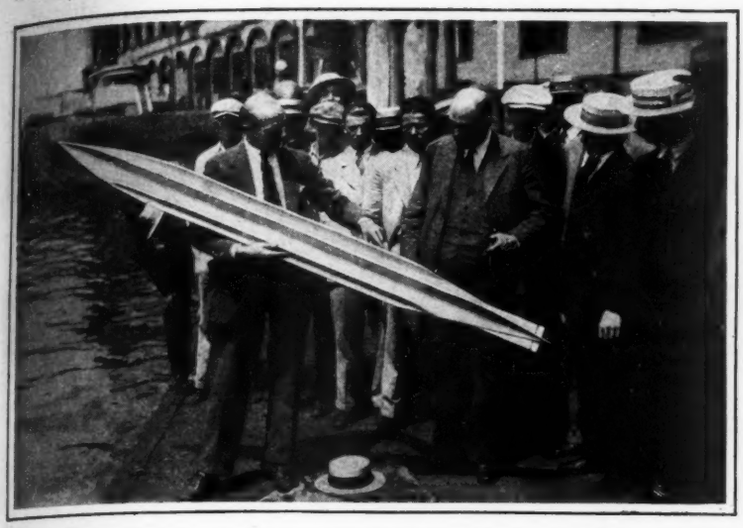
The "fighting face" of a battleship is shown in the unique photograph at the left, taken at an angle to make the hawse-holes in the bow look like a monster's eyes, the anchor like its teeth



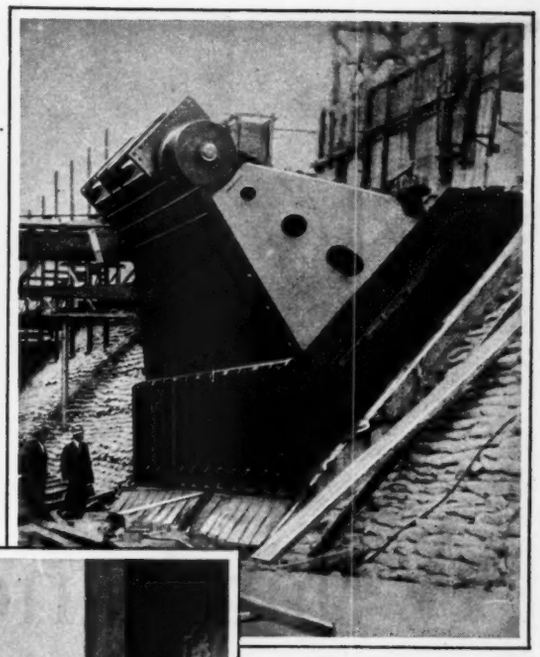


Chamberlin heads through the storm for Curtiss Field in his take-off from the *Leviathan* to prove the feasibility of speeding mail from ships by plane. From Curtiss Field he flew with the ship's mail to Teterboro Field, N. J. The Post Office Department, encouraged by the feat, is considering having each liner carry an airplane to rush mail away when it is within a few hundred miles of port—a plan which will greatly facilitate the distribution of postal matter

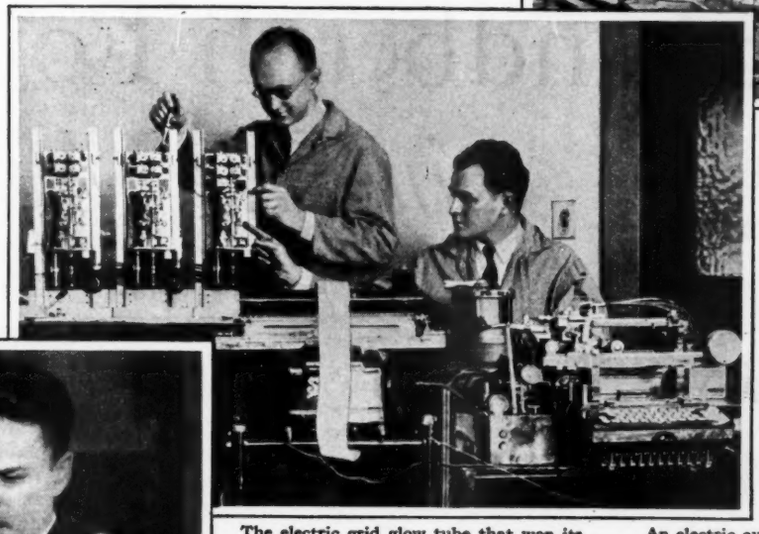
Chamberlin, just arrived at Teterboro Field, N. J., delivers mail he brought through storm from the *Leviathan*, several hours away from New York Harbor



A speedboat that can cross the Atlantic in twenty-four hours and go around the world in a few days is proposed by Max Kleon, of New York, its inventor, who is exhibiting a model of the craft. With its perfect streamline shape and its long-finned keel, which he is explaining, he declares the craft can make 180 miles an hour when driven by an engine of fair power. The designer credits the long underfin for the superior speed he claims

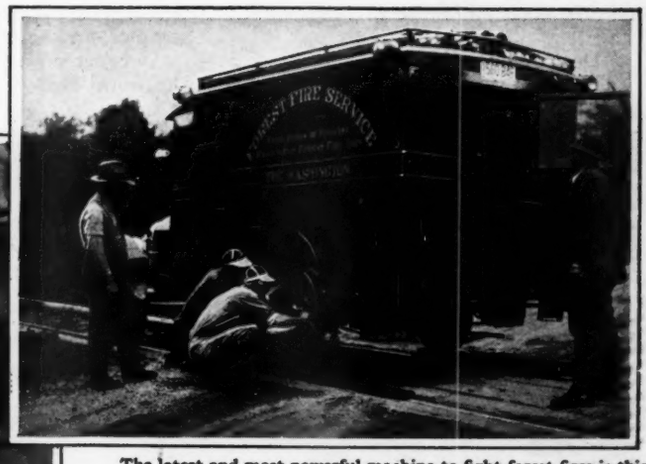


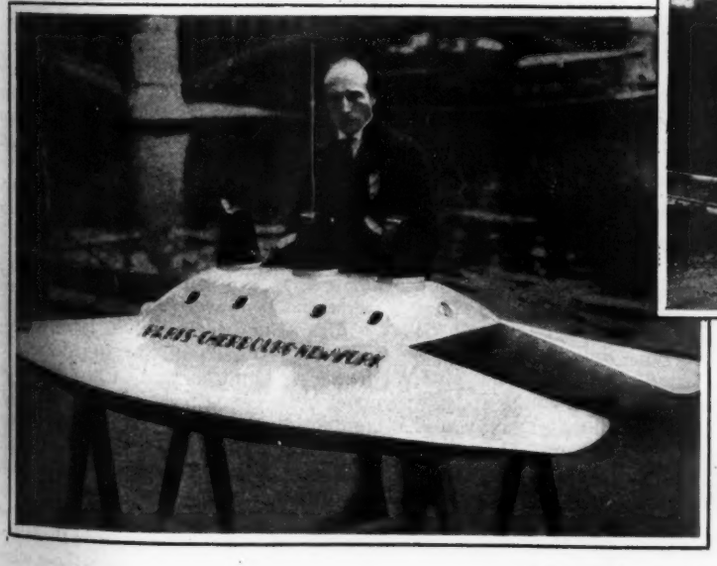
Fifty million pounds will be supported by four gigantic 300-ton bearings like that in the illustration above, just installed at Dawes Point, Sydney, Australia, to bear the weight of the steel arch bridge that will span Sydney harbor. Two are used at each end of the bridge. They permit expansion of the girders, due to hot weather, thus averting resistless pressure that would crack the foundations of the structure, eventually wrecking it



The electric grid glow tube that won its 28-year-old inventor, D. D. Knowles, the John Scott $1,000 prize and medal, is shown at the left. Knowles operates this most sensitive current control device, previously described in POPULAR SCIENCE MONTHLY, by waving his hand near it

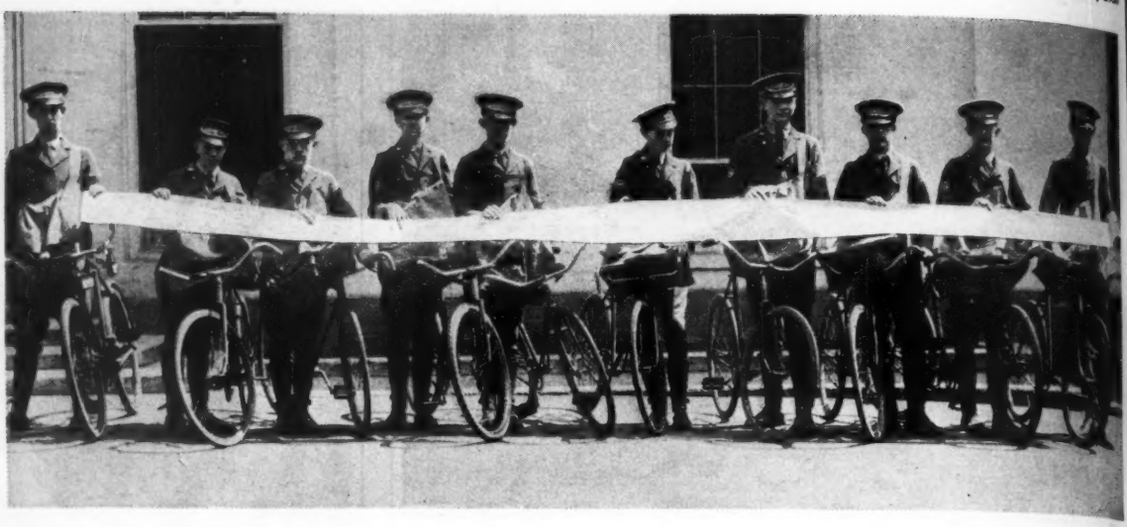
An electric auditor, pictured to the left above, will save 60 per cent of clerical labor by recording all sales and other data usually written down by salespeople in stores. They press buttons; the machine does the rest. Professor Woodruff, Massachusetts Technology Institute, and Edward Rogal, a former instructor, made it





The latest and most powerful machine to fight forest fires is this —in use in the Northwest. It races on steel wheels on railroad tracks to the point nearest the fire, then changes to rubber-tired wheels and goes on. One engine drives it and, arrived at the fire, operates pumps for four one-and-a-half-inch streams of water

No rudder is required for the queer speedboat pictured at the left with Adrien Remy, its French inventor, who says it will bring him across the Atlantic at forty miles an hour. The three air propellers at the top drive the two-hulled boat. By shifting the three engines in the cabin that connects the hulls, one side or the other is lowered, altering the course toward the low side



A congratulatory telegram 520 feet long with 17,500 signatures, sent from Minneapolis to Col. Lindbergh in Washington, on a special direct wire. One telegram sent from St. Louis had 2,000 names

What Lindbergh Found *in His* Mail Bag

Offers of Millions, Offers of Marriage and 14,000 Gifts in Packages Sent to Atlantic Flyer

By FITZHUGH GREEN

THROUGH the crowded events that followed the great flight to Paris, the author of this article was one of Col. Lindbergh's chief aides. And in the swift preparation of Lindbergh's book "We," he wrote several chapters describing the welcoming receptions which the modest aviator did not wish to write himself. Commander Green also aided in handling Lindbergh's huge mail.

"Dear Lindy—"

Those two words, with variations, have been written more than three and a half million times in the last four months by people of all races, colors and climes.

No one man in history ever received such a mountain of mail as has Colonel Charles A. Lindbergh since that memorable May 21 when he completed his lone flight from New York to Paris by plane. Between that day and June 17, when he landed in St. Louis after an unprecedented welcome by mankind, there came to him, from every corner of the globe, more than 3,500,000 letters, 100,000 telegrams and cablegrams of congratulation and 14,000 parcel post packages containing gifts, samples, and articles for trade!

And even now, nearly four months after the world first went mad over his magnificent feat, scores of secretaries and postal clerks are still busy sorting and classifying the great piles of communications to the young aviator, whose daily mail continues to be greater than most of us receive in a month.

Checking up part of Lindbergh's Washington mail. Left to right, Postmaster General New, Postmaster Mooney, and Assistant Postmaster General Glover going over one of the many truckloads sent to the flyer

If we should suddenly find ourselves in Lindbergh's place, the recipients of millions of messages, gifts and pleas from young and old, the fortunate and the miserable of almost every race and nationality, what should we do about it? How should we feel and act?

Because I have chanced to be one of many to assist in the gigantic task of doing at least something about the kindly millions who sent their congratulations and gifts, perhaps I can help you put yourself for a moment in Lindbergh's place.

I know that when the first great bulk of cablegrams and letters arrived for "Slim" at the American Embassy in Paris, he was deeply touched and profoundly interested. He was thrilled that thousands upon thousands whose names were strange to him, and whose faces he had never seen, should thus shower him with personal tributes. And his first impulse was to read every letter, and answer each in turn with his own hand.

BUT that first impulse soon changed to something like bewilderment when, on the second day after his arrival in Paris, a large room had to be commandeered for the first of this mail, and Ambassador Herrick assigned eight of his own staff to handle the correspondence. By the second night another tidal wave of cables, sweeping in from America, swamped the secretarial force, which by that time had been trebled. Even while the secretaries toiled far into the night, they gave up all hope of answering each missive in the sea of white and yellow envelopes.

Not so Lindbergh. When, later, the deluge was repeated in varying degrees in Brussels, London and Cherbourg, he never quite gave up the idea of eventually completing the appalling task of answering unseen millions who spoke to him.

The simply worded messages from mothers who poured out their hearts in joy at his safe landing—the letters in the trembling hand of old age, or in the faltering form of the very young—those other

jubilant congratulations from rulers, presidents, scientists, educators, business men, soldiers, sailors, clerks, street cleaners, even tramps and beggars—all these voices seemed to hold him duty bound, the while they overwhelmed him.

Only when he reached America, and received the full volume of the welcome home, was he at last compelled to throw up his hands in despair. In Washington three mail trucks brought him letters that had collected during his passage home on the U. S. S. *Memphis*. A huge Western Union bus with ten messengers carried the telegrams for him. Ten one-ton trucks could not have transported all the parcel post intended for his hand! In New York scores of aides, clerks and stenographers struggled in vain to keep pace with the ever rising tide.

YET, withal, it required some argument to convince the boy that personal acknowledgment would be beyond the power of any man.

It was pointed out to him that a high speed business executive with a force of expert stenographers might average 200 replies a day. At that rate he might clean up Lindbergh's stack of mail in about seventy years! Only, before he could finish two thirds of it, he'd be dead of old age!

Moreover, Lindbergh was reminded of the fact that he knows neither how to dictate nor to typewrite. He writes everything—even his book—in longhand. If he should work at top speed on the letters every day, he'd have the job done in about 150 years. The letterheads alone in this mail of his, if placed end to end, would stretch from New York to Denver. Stack all this mail in a single pile, and it would reach 10,000 feet into the sky, nearly to the height of Pikes Peak!

So, in the end, although in St. Louis a force of fifteen secretaries of the Chamber of Commerce did manage in six weeks to acknowledge 200,000 letters addressed to him there, Colonel Lindbergh has had for the most part to content himself with the hope that his unanswered friends will see his predicament and understand.

PERHAPS, after all, it is well that this is so. I have read hundreds of the letters which Lindbergh himself never has had opportunity to see. Many of them would tear at his heart strings. While some offer opportunities for wealth beyond the dreams of most men, others would tug at his purse strings. If he should respond to a small portion of the pitiful appeals for help contained he would soon be impoverished. While he would be gladdened by the sincere generosity of everyday people, he would be saddened, too, by the avarice, treachery and deceit which my eyes so often read between the lines.

What a revelation of human character there!

The largest number, of course, were letters of congratulation. Most of these were couched in the simple, kindly language of home folks. I pick up one at random and read: "Dear Colonel Lindbergh: Oh, we are so happy you got there. May God bless and keep you for your mother and for us." Such was the gist of thousands upon thousands of messages from American fathers and mothers.

You too would scratch your head if you had flown across the Atlantic and your congratulatory mail mounted to so many tons that it would take you 150 years to answer all of the messages

Not a few communications were amusing for the "five-dollar" words they contained. One began: "Fair-haired Apollo, your meteoric traverse of the sea, your transcendant victory over boundless space, shall thunder down the avenues of time!"—And so on for several resounding pages of closely written foolscap.

Requests for help came next. There were entreaties based on purported old friendship, on relationship, on past favors, and on the utter poverty of the writers.

I believe there was not a single man or woman of the hundreds that worked on Lindbergh's mail who did not shed many tears. So plainly grievous were many cases that it shocked us, as I know it would have shocked Lindbergh, to realize there was such abject misery in this rich country of ours.

A widow wrote that she had been bedridden for eighteen years. "A little money will do," she urged, "maybe ten or fifteen dollars. That will give me a chance to get new curtains for the room in which I have lain for so many years."

Sick people, the financially down and out, struggling widows, orphans, a wife who had left her husband and was trying to earn an independent living, the discontented daughter who had sought her fortune in the city and found only discouragement and failure—thousands of these unhappy people felt called upon to lay their cases before the young man who flew to Paris.

Some requests for help were more entertaining than heart-rending. The owner of a small-town garage wrote that he had been having trouble with valves and considered Lindbergh "just the fellow to help me out."

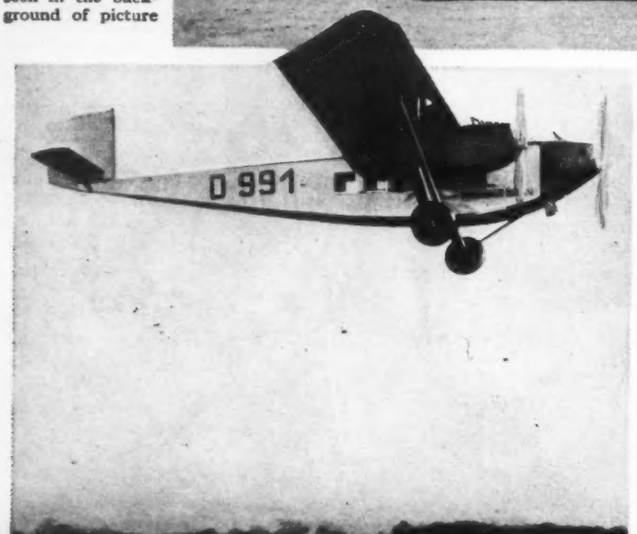
"I HAVE ground the valves with carborundum dust and on a stone," he said, "but they seem to leak. I want to know what you think about this. You seem to know your engines pretty well. Or else you would have broken them down long ago. It may be that I am not doing the job thoroughly enough. You see I have had a good deal of trouble lately. We live with my wife's mother. She bothers Minnie (my wife) a little, especially in the evenings. So next morning I haven't got my mind on the job.

"Better write me direct to the shop, and don't mention the mother-in-law. What I want is advice on valves."

The letters were in every conceivable form. More were in longhand than in type; more in (*Continued on page 179*)

The huge British transport plane at right carries twenty-five soldiers, fully equipped. An ambulance plane of equal size may be seen in the background of picture

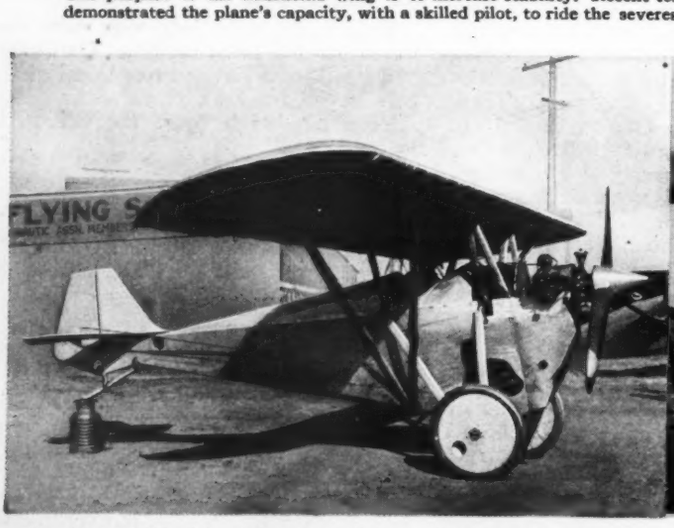
New Air Liners and "Flivvers"



The latest type of Rohrbach "Roland" ten-passenger monoplane, photographed while passing over the Copenhagen Airdrome, Denmark. The ship is driven by three motors and has been pronounced as safe as any motor car

Interior view of the German-built Junker all-metal fifteen-passenger plane, the type in regular European, Asiatic and South American service. Armchairs in the seven-foot-wide cabin are easily converted into comfortable berths

An extra wing between the tail and the cockpit is the innovation embodied by M. Albessard, a French aeronautical engineer, in a new type machine which he calls a "double monoplane." The purpose of the additional wing is to increase stability. Recent tests are said to have demonstrated the plane's capacity, with a skilled pilot, to ride the severest storms in safety



San Diego, Calif., claims this as the smallest monoplane in the world. It weighs only 600 pounds. The wing span is twenty feet and the length seventeen. Its two-cylinder motor develops twenty-eight horsepower. Fuel for two hours can be carried in its gas tank. W. F. Hopkins (in the cockpit) and T. Mead, Navy men, built the ship in their spare time

The Cockle, smallest flying boat ever built in England, has been purchased by the Air Ministry for experimental purposes. It is all metal, except for fabric covering the wings and sail. The speed, carrying pilot and fuel for two and a half hours, is sixty-four miles an hour; the rate of climb, 150 feet a minute. The landing speed is thirty-five miles an hour

Babies *Born Today* May See—

Cities of 30,000,000, Skyscraper Sidewalks, Roof Top Airports and Food Piped As Water Is Today

By MYRON M. STEARNS

FROM the height of a great precipice two men looked down on a continuous stream of moving automobiles. Farther from the ground than the Palisades rise above the Hudson River at the highest point, they were on no natural crag. They were looking down from a window on the twentieth story of a New York hotel—not a fabulous building of a hundred years hence—but a matter-of-fact structure of today.

Dinner was served in their room. The fish had traveled more than 6,000 miles to reach them—Alaska salmon. The steak came from a steer raised near the Mexican border, shipped a thousand miles to be "finished" by a special feeding, another five hundred miles to be dressed, and still another thousand miles in refrigerator cars to reach the metropolis. Fruit from Southern California, vegetables from Georgia, olives from Italy. And the eggs in the Mayonnaise dressing for the salad—no joking—were laid on the other side of the world, in China, nearly two years before. It was good Mayonnaise, too.

There was a knock at the door. It was a bell boy with a letter that had traveled 3,000 miles to reach them in little more than two days. It was the air mail from San Francisco.

After dinner, the travelers stepped on a little covered platform and dropped three hundred feet to the ground floor. Merely a commonplace express elevator.

In a city where such wonders are already taken for granted, what will conditions be in another seventy-five years?

Let us suppose one of the men is eighty years old. Every one of these marvels has come about during his lifetime. He may have a grandson who is seven. By the time that boy reaches eighty, the end of the century—2,000 A.D.—will have come. Only a lifetime away! Will that lifetime see as great changes as the last—or still greater?

NEW YORK CITY in another seventy-three years, according to the scientific calculations of Dr. Raymond Pearl, Director of the Institute of Biological Research at Johns Hopkins University, will be more than twice as big as it is today. The city proper will have a population of 13,948,000. In the area described as "Greater New York" there will be 17,797,000 people; and in the suburban area the total population, according to figures based on the law of growth described in the June POPULAR SCIENCE MONTHLY, will be 28,765,000. How will such an enormous city be cared for?

Chicago, Los Angeles and Detroit will have population problems almost as serious. Other great cities—Seattle, Galveston, perhaps Charleston, S. C.,—will likewise have had to turn to modern science to solve difficulties of congested living.

The population problems of every great city fall into three fields: Housing, feeding, and transportation. New York City in 2,000 A.D. will have advanced farther in these fields than we can even imagine clearly today. But in all probability transportation matters will be the most pressing—just as they are today. Problems of feeding have to be solved before people can even go to live in a city in such great numbers, and housing problems also have to be met.

This photograph shows the first, second and third and last stages of the bottle of fruit flies by which Dr. Raymond Pearl, Johns Hopkins biologist, made final proof of law of population growth (described in June POPULAR SCIENCE MONTHLY) by which he predicts 13,948,000 inhabitants for Greater New York in 2,000 A.D. Two flies, placed in the bottle, multiplied until the population was as great as space and food allowed. Then only enough flies were hatched to replace those dying

Transportation of food and transportation of building materials will run along smoothly enough, but transportation of people goes forward, in congested centers, only when conditions become intolerable. That will be as true in 2,000 A.D. as it is today. Our grandchildren and great grandchildren will get into some terrific traffic jams! When, for instance, they have to fly over the city for miles before they find a single public landing-stage with room left for them to park on. Or they may have to stand, packed like sardines, for three quarters of an hour, evening after evening, before they can fight their way onto one of the great tunnel-buses of the Underground!

Let's take up the matter of feeding. How will thirty million people in the Greater New York area of 2,000 A.D. get their food? And what will it be?

Huge engineering projects, of course, will have been carried out to provide the immense city of the future with an abundant water supply. But unless one should visit the great artificial lakes and reservoirs of that day, it is likely that the huge dams and tunnels and aqueducts will be little better known than is the eighteen-mile Shandaken Tunnel of the New York water supply today. Far more amazing, perhaps, will be huge pipe lines of milk, carrying great white streams into the city from the dairy regions, 200 miles away.

IN LARGE measure, probably, the food itself will not be so very different from what we are accustomed to today. There is a possibility that new discoveries, like the "artificial sunlight" that Professor Steenbock of the University of Wisconsin has produced to make Vitamin D, will change food conditions greatly. But it seems rather unlikely. The further scientists delve into the chemical analysis of living tissue and digestive processes, the further they find they must go before they reach the ability to reproduce Nature's own processes.

On the other hand, Professor Edgar M. East, of Harvard University, points out that foods will probably be much less varied fifty or seventy-five years from now than today. There will be a wider use of cereals, but not so many kinds of cereals. The same will probably be true of vegetables. Fruits will have tended to "standardize," with a few varieties like apples and oranges, or possibly coconuts or some other tropical product, far outstripping all the rest.

The use of meats, fish and other sea foods will probably have diminished greatly. Seventy-five years ago, in the period before the Civil War, New York menus, Professor East points out, listed a variety of game that would make an epicure's mouth water today—some fifty varieties. Food is most varied when a country is new; as the population increases, certain staples of diet come to be more and more widely used. The New Yorkers of 2,000 A.D. will probably eat quantities of a prepared food made from some such cereal as Egyptian corn, that can be grown cheaply and brought in large quantities from lands now only partially productive in the South. Or perhaps it may still be wheat.

Charles P. Steinmetz, the great electrical wizard, had a dream that some day laboratory products would supplant the present round of meats and vege-

tables. He visioned huge protein farms constructed underground in layers, sunned with artificial light. The English scientist, J. B. S. Haldane, pictures the day of synthetic foods, chemically produced, in his book of the future—"Daedalus." But these visions are not likely to materialize within seventy-five years.

To be sure, ground that is today going to waste will be used for agricultural purposes, just as in Holland and Belgium and Germany every strip along the roadside is made to bear its harvest.

But the plants themselves, in spite of all that Burbank and his followers have shown us, will not have changed very greatly. Dr. William Crocker, Director of the Boyce Thompson Institute of Plant Research, points out that it takes something like fifteen years to find, try out and introduce on a wide scale any improvement in a staple like wheat.

Our children and grandchildren, he predicted to me, will be eating food not particularly different from much that is found in the world today; but in the preparation of that food there will be a great difference.

Many people believe that skyscraper hotels, apartments and office buildings are rapidly approaching their limit of height. But one of our greatest architects, Harvey Wiley Corbett, of New York City, said to me:

"DON'T think of skyscrapers in terms of the men who build them if you want to get an idea of what a city of the future may look like. Think of future cities, or groups of skyscrapers, as you think of coral islands or trees, with the human beings playing merely the part of coral insects, or of the sap that builds trees. Compare the New York skyline to a coral reef, or a bunch of skyscrapers to a grove of trees, and you can get an idea of how much a city like New York will grow and change in another three quarters of a century."

He added that no one can yet prophesy what height buildings will reach, but that in all probability the end is not yet anywhere near in sight. A hundred stories are not beyond possibility, even within thirty years.

"Why," said Mr. Corbett, "I was present at the party given in honor of the completion of the Pulitzer Building in Park Row. Several of the great architects of that day were present, and they agreed the building marked the limit of the height that skyscrapers could attain. The physical problems to be overcome, the structural problems, were so great that they thought man could never build higher than that. Yet today the Woolworth Building is more than three times as high. And every decade sees the limit advanced."

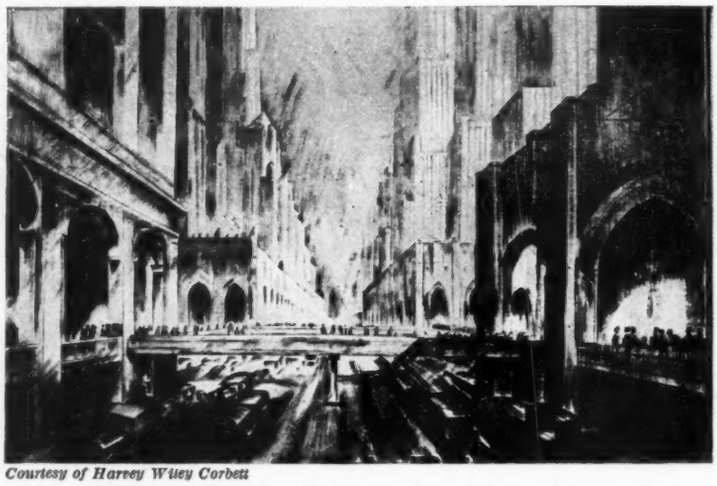
Building restrictions in New York City, to be sure, just at present make much taller structures seem unlikely. But Mr. Corbett pointed out that limitations of the height of buildings come merely in response to the needs and demands of the moment, and will be wiped out again as soon as new needs demand greater edifices once more.

Another thing: While some buildings, at least, will be far taller than the world knows today, many will be larger. A single apartment hotel, forty stories high and covering an entire block, will be nothing unusual. Some may house 10,000 or more people, and supply them with food from a single kitchen. Perhaps there will be Government inspectors on hand to see that all food is treated with violet ray, potassium permanganate, or some other disease-combating chemical.

Sidewalk bridges hundreds of feet above the streets may be used in this New York of 2,000. We can already see their first beginnings in the occasional high bridges across street chasms, from one office building to another in lower Manhattan. Building permits have already been granted that will mean more of these further uptown, in the immediate future. From the fortieth story, or perhaps the eightieth, men of 2,000 A.D. will walk straight to the corresponding floor of the building across the way.

It is likely that, with thirty- or forty-story buildings, continuous sidewalks 400 to 500 feet in the air will join building to building for blocks, even miles.

Roadways will probably cross the street from side to side, high in the air. Already an Englishman, Lord Montague, has proposed viaducts running 200 feet above the present street level for London. But this development would shut off too much light from the street below, and render the chasm itself practically useless. New York's elevated railroads now seem doomed for this reason. In their place the huge automobile highways of the future city will probably run across the housetops.



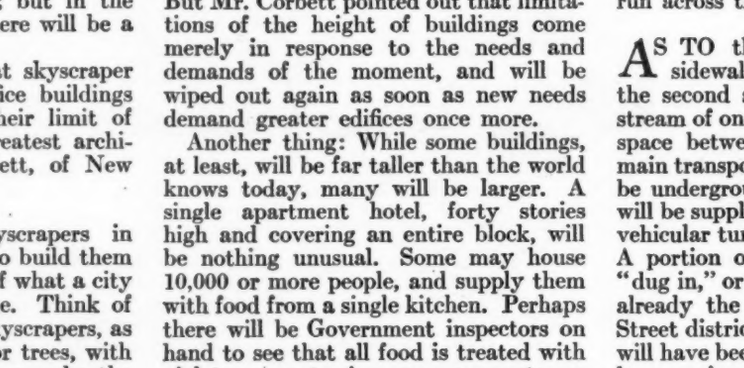
Courtesy of Harvey Wiley Corbett

An architect's conception of a city street in 1975. Between skyscraper apartments, with conveniently adjacent schools, hotels and stores all street level space is used for vehicle traffic. Sidewalks for pedestrians and street crossings are elevated. Huge motor trucks below move in lanes of various speeds

AS TO the present-level streets, the sidewalks will probably be raised to the second story level to permit a full stream of one-way traffic, utilizing all the space between the buildings. But the main transportation system will probably be underground. Subways and railways will be supplanted by a whole network of vehicular tunnels along the main arteries. A portion of the whole city will have "dug in," or gone underground, just as is already the case of parts of the Wall Street district. The intersection problem will have been overcome, in part at least, by carrying one artery above the other at all main crossings.

Streets on five levels have been prophesied. At first this seems very unlikely, but if we stop to think a moment we find that to a surprising extent the condition has already come close to existence. If you stand in Forty-second Street, New York, for instance, in front of the Grand Central Station, there is a viaduct over you. That is one level. Forty-second Street itself is on the second level—the ground level. Go down into Grand Central Station, and you find trains below the present level of Park Avenue. They are on the third level. The "lower level" suburban trains are on still a fourth level down. About on this same fourth level is the Lexington Avenue subway. And another flight down—fifth level—is the Queensboro subway.

(*Continued on page 166*)



Courtesy of Detroit Rapid Transit Commission

A "superhighway system" to meet future traffic problems. Vehicles for passengers and freight will travel in various lanes and at various levels according to their speed

Ladybugs being released, ten from a capsule, to feed upon and destroy mealy bugs that infest the trees in California's orange groves

H. M. Armitage, horticulturist, holds a burlap band around an orange tree infested with mealy bugs, which swarm to the burlap as a favorable place to lay eggs. There ladybugs, raised for the purpose, attack and destroy them. On the band are insects of both kinds participants in the man-directed war to save the fruit trees

Ladybugs Bred to Slay Pests

Australian Beetles Grown by Millions in California Nursery for War on Insects That Ravage Orange Groves

By ARTHUR A. STUART

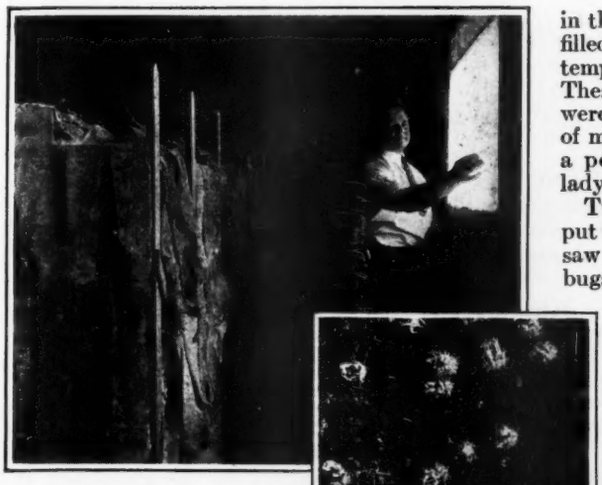
JUST a few days ago, a county plant expert walked into a southern California orange grove to a tree whose trunk was spotted with tiny black-winged insects, and snapped open an inch-long gelatine capsule he had in his hand. Out flew ten ladybugs, among them one of especial distinction. It was the four millionth bred and released this year by the Los Angeles County Horticultural Department in the battle it has just commenced to win against the mealy bug, destroyer of fruit trees.

Perhaps you have thought of the familiar ladybug as a winged creature whose only mission in life is to "fly away home," nursery rhyme style. But such importance do plant growers attach to this tiny beetle that they have started one of the most unusual farms in the world—where ladybugs are raised by the million, under attentive care of experts!

When California orange growers became alarmed not long ago at a curious scale-like insect in their groves, they knew of no way to combat it. Tiny white mealy bugs overran their trees and destroyed them by sucking the sap from tender sprigs. The bugs wore a heavy wax coat that protected them perfectly from spraying or fumigation. They were multiplying fast. What could be done?

Ladybugs were the answer, the ranchers found. To a ladybug, a swarm of mealy bugs is the finest banquet imaginable. The ordinary ladybug makes a meal on the diminutive green plant-lice that ants keep as "cows," "milking" them for their honey and incidentally saving the plants. Perhaps there was a kind of ladybug that would eat up the orange tree enemies of California.

They found it in Australia, hiding beneath the imposing name of *Cryptolaemus montrouieri*—a name five or ten times as long as the insect itself. Albert Koebele, working for the California and U. S. Departments of Agriculture, discovered it and brought back cases of the beetles—ladybugs, of course, are really not bugs at all—which thrived on California mealy bugs. But in such small numbers, they could not keep pace with the orange tree scale.



In a breeding room, above, newly developed ladybugs swarm to gauze spread over a window, from which they are collected. At right are shown a number of larvae of ladybugs emerging from the eggs

So at Rivera, Calif., in the heart of the infested region, the ladybug farm was established to grow the "Cryps," as the workers dub them, by the million! Last November whole potatoes were sprouted, in thousands of redwood trays filled with prepared soil, in temperature-controlled rooms. These sprouts, by January, were ready to receive swarms of mealy bugs that would serve a peculiar purpose—induce ladybugs to lay eggs.

Twenty-five ladybugs were put in each tray. The beetles saw in the swarming mealy bugs abundant food for their young and set about laying eggs. Two weeks later, each tray contained 300 to 1000 embryo ladybugs.

At the end of a week—early in March—the trays were filled with ladybug larvae just hatched. They retired into cocoonlike shells. In April out came the adult "Cryps." Under the direction of H. M. Armitage, of the Los Angeles County Horticultural Department, the ladybugs were "bottled" in gelatine capsules, taken into the groves and released. The first few soon multiplied. Had all their descendants lived, there would have been 100,000 children of each original ten parents by the third generation—a month and a half later. This generation was the one that gained control over the pests. By the time you read this, the mealy bug plague is likely to be a thing of the past.

The average production of ladybugs is now 50,000 a day!

The plane seemed to sense at once that a guiding hand no longer grasped the control stick. Its right wing dropped; it went into a right turn, then quickly into a spin

Tails Up!

A Test Pilot's Thrilling Ride in a Bucking Plane

By CY CALDWELL

The story related here by Mr. Caldwell, a veteran test pilot, is based on the actual experience of one of the men whose job it is to put new and untried planes through their paces

"HOLY mackerel! What's the matter with him?" shouted the general manager of the airplane factory as he watched the company's latest production, a huge monoplane, on its first test flight.

The chief engineer turned pale as he saw the plane glide toward the flying field with motor running at half speed, and skim across the runway at eighty miles an hour. For a moment, the motor was throttled down, then advanced to full speed as the plane soared into the air again to circle the field and try for another landing—the fourth try. The chief engineer turned paler.

"He can't land! Here, Benson!" he shouted to the assembly foreman. "Bring the rest of those fire extinguishers and two men—hop in my car. And Smith—phone for an ambulance. Hurry now!"

With the general manager seated beside him, and with the foreman and the men with fire extinguishers piled in the rear seat, the chief engineer drove at full speed across the flying field, and stopped near the end of the runway.

"Spread out," he ordered, "and if he crashes, get to him as quickly as you can! Leave me one of those extinguishers—we'll stay in the car."

"Now what's the matter with him, anyhow!" the general manager repeated, puffing nervously at his pipe. "He can't seem to get the tail down. Soon as he shuts off, the tail goes up—did you see it?"

"I did," the chief replied grimly. "The ship is away nose-heavy with motor off. Here he comes; now watch the elevators."

The monoplane, a large fleet-spotter built for the Navy, glided down with throttled motor toward the far end of the field. The nose of the machine inclined more and more toward the earth, while the tail rose higher and higher, until the plane was nearly in a dive. Then the motor roared into full power, and the nose leveled off just before the plane reached the ground—at which moment the pilot again throttled his motor. As he did so, the nose again dipped slowly toward the ash runway, a foot below, the tail rose, and the wheels touched. The machine bounced, the motor roared on again, and the plane shot past the men scattered about the end of the field. It leaped into the air, barely clearing a line of telephone and light wires that bordered the field.

"WHERE'S that ambulance?" groaned the general manager. "He's going to crash, sure! Did you see those elevators way up? He was using all he had. Sure your center of gravity is right?"

"Certain of it," replied the chief engineer. "It's that confounded ballast that has slipped forward. You know we had to put in over 400 pounds of sandbags to replace the weight of gunner, machine gun, ammunition, and radio equipment—417 pounds in the rear of the gunner's compartment, just balances. . . . Well, I suppose it slid to the front—I wouldn't be surprised if it had shot right through into the observer's cabin—come down that little runway, you know. I wonder . . ."

The test pilot was doing some wondering, too, as he tried desperately to get that plane to earth. He was wondering what peculiar lack of brains had induced him to become a test pilot, anyhow: and, having become one, what had made him do a whip-stall—which undoubtedly had shifted the ballast.

He had taken the plane up for its initial test flight, had flown it without difficulty, had tried turns and glides. Everything had been all right, until he had tried to stall—pulled the nose up in the air until all flying speed had been lost. Then he had kicked on left rudder, the plane had whipped around and done the first half-turn of a spin before it dived straight down, and then had come out level—very slowly, and only after he had advanced the throttle and pulled back on the control column.

He had been mildly surprised at that. From the way the stabilizer plane was set, the machine should have taken its own gliding angle with motor throttled. He throttled again—and watched the nose dip farther and farther downward, until it pointed almost vertically to the ground, its tail cocked up to the blue sky. Although he pulled back on the elevator control, which regulates the up and down movement of the plane by changing the angle of attack on the air, no appreciable difference was noticeable in the angle of descent. The plane still dropped like a stone.

He was an experienced and capable pilot, one not easily flustered. He knew that if the tail would not drop level by pulling back on the elevators, it would drop if blown down by the force of the slip-stream from the propeller on the raised control surfaces. So he advanced his throttle until the motor was running full speed. The plane came slowly out of its dive a few hundred feet above the ground, and sailed on serenely in normal level flight. Up to 2,000 feet the pilot climbed, and tried to glide again. The glide had been deftly removed

The pilot knew the men on the ground had sent a hurry call for an ambulance. Perhaps he'd better stay up in the air until the ambulance arrived!

from that airplane! All that it possessed with motor throttled was an insane desire to hurl itself nose first against the world!

The pilot took a handkerchief from his pocket and mopped his forehead. How could he land if he couldn't shut his engine off without the tail going up?

He flew around the field grappling with his problem. The controls were all right; he could look back over the fat, swelling wing of the monoplane and see the elevators and the rudder move when he moved his hands and feet. But something had happened. Obviously, the ballast in the rear cockpit must have slipped forward, throwing his center of gravity, or fore and aft balance, away ahead, making the plane nose-heavy and tail-light.

BUT explanations are usually easier to find than are solutions, as he soon discovered. As a jar had shot the ballast forward, he reasoned that another jar should shoot it back. So he proceeded to supply the jar. He put the motor on full and dived slightly to get up speed. Then he pulled back on the control wheel until the plane almost stood on its tail. Then, before it could lose flying speed and stall, he pushed forward on the control wheel, with motor still full on. The plane hung for a moment, dropped its nose level, and before it had dropped far below level, forged ahead.

The pilot had felt a slight shock as the plane stood on its tail. He smiled grimly, thinking that the ballast had slid back into place. "Got you!" he thought. "You blank blank ballast!" But a moment later, when he throttled down again and tried a glide, the machine dived for the ground just as it had done before!

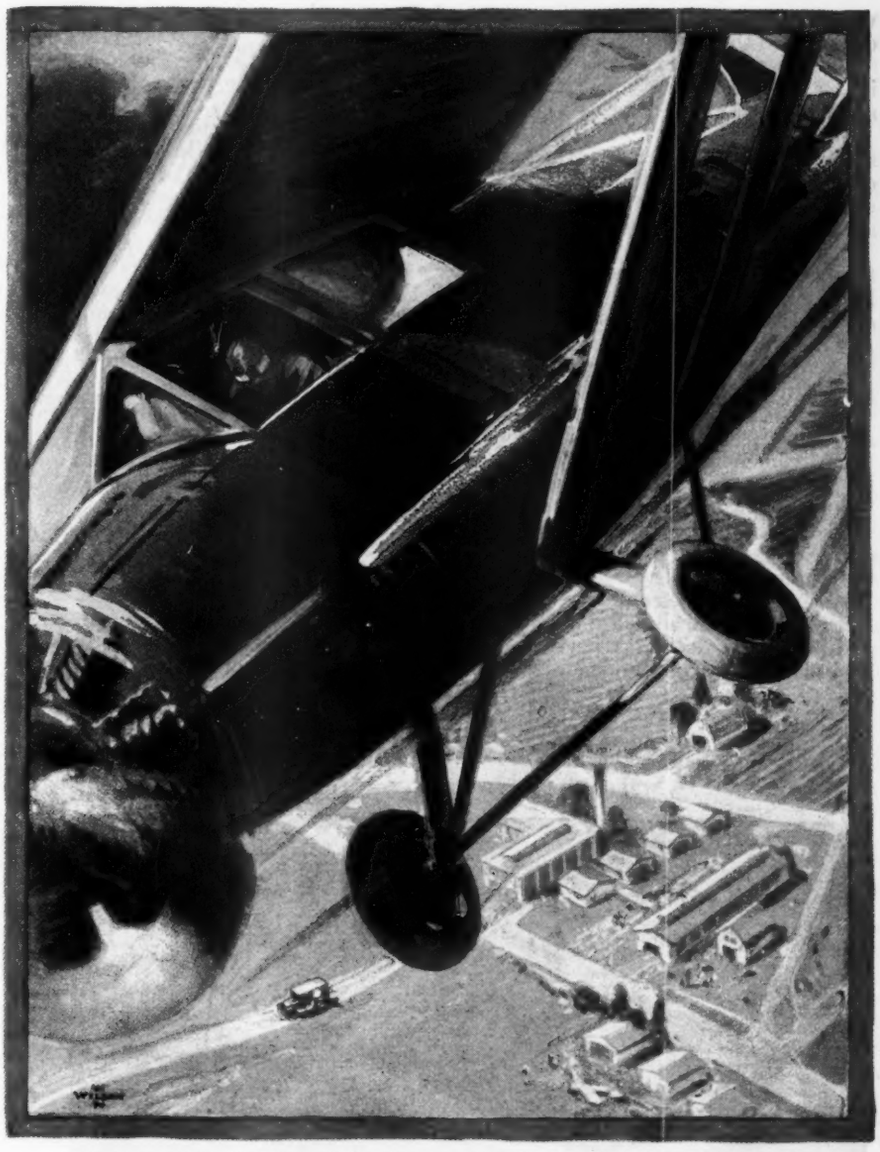
He was in a bad fix, and he knew it. Just as certainly as though he had crawled back into that cabin in the fuselage, he knew what had occurred. The ballast not only had slipped its lashings and slid to the front of the gunner's compartment—it had shot right through the little tunnel that communicates with the observer's cabin. And as the cabin was almost a foot lower than the flooring of the gunner's standing place, it was manifestly impossible to jump it up and back. He could slide that ballast back to the rear of the observer's cabin; he could loop and let it fall on the roof. But he could not shoot it up and back. Where it was, it would stay.

He knew he could not glide down after the usual manner, with motor throttled down, and the machine making a gentle sixty miles an hour. His one chance would be to fly down with engine over half power, land very fast, say eighty, and hope for the best. But what would the best be? So soon as the slipstream stopped pounding down on the tail, the light tail would rise like a rocket, the nose would bow to the ground—and the machine would somersault at eighty miles an hour.

DOWN he came, the motor roaring merrily, the nose just a little below level. A few feet from the ground he was flying tail up at over eighty miles an hour, a speed that would have taken him across the small factory field and into a line of freight cars on a siding at the far end, even allowing that the plane didn't somersault. He breathed a short and fervent prayer to the gods of the pilots, whose names are Luck and Experience, named in the order of their importance.

The gods whispered to him not to land that time, and he didn't. He gritted his teeth and shoved the throttle forward as far as it would go. The tail fell, and the plane shot up and roared over the telephone wires.

The pilot glanced forlornly over the side. He could see the general manager and the chief engineer in their car; he could see mechanics scattered along the edges of the runway; he could see a closed motor car that looked surprisingly like an ambulance. A man in white was standing beside it looking up.



He advanced the throttle, and the plane came slowly out of its dive. The machine seemed possessed with an insane desire to hurl itself nose first against the world!

Up he went, turned straight for the course, and tried it again. This time he was making about seventy with the tail nearly level. Just as the wheels touched, he throttled back to see what would happen. If the tail stayed down he would switch off and let the plane run—even if it did bump into those cars; but if the tail went up—! The tail did go up, so he put on the engine again—just in time. The plane rose. Again he looked over the side. No, it wasn't an ambulance! It was the baker's wagon. And that man in white was the baker's man. But they had probably sent for the ambulance. Perhaps he'd better stay up until the ambulance arrived.

He thought of one possible way out—a slim chance, but worth trying. In the observer's cabin was a dual control stick; or rather, there was a fitting for a control stick to go into, for he had taken out the stick himself before the flight—to make sure it should not interfere with anything. His caution had been his undoing, for he could not move the controls with that short control-socket. He needed a stick for leverage. He looked around him desperately. There was the fire extinguisher. If he could take it apart—but it wouldn't fit the socket. Not a tool on board, of course.

Meanwhile he was climbing, getting as far away from that hard ground as he could. Up to 5,000 feet he went. If he could climb back into the observer's cabin and shift the ballast—! Easy enough to get back, by sliding down over the wing and entering through a trapdoor in the roof of the cabin. But what would the plane do meanwhile? He took his feet off the rudder bar, his hand from the stick. Slowly and with some dignity the plane turned to the right, the right wing dropped. That was its nature from the way it was rigged. And that was what

would happen if he let go and climbed back into the observer's cabin. And the next thing would be a spin.

But it was his last chance. He leveled the plane; then put it into a left turn. He knew it would take a few moments to straighten out and turn of its own accord to the right.

There was no time to lose. Unfastening his safety belt, he scampered like a squirrel over the swelling top of the wing and disappeared in the little trapdoor. The plane seemed to know at once that the firm guiding hand no longer grasped the control stick. Swiftly it went into the right turn, then into a spin.

Meanwhile the pilot was frantically hurling sandbags up through the runway tunnel into the gunner's compartment. As he felt the ship start its turn he grabbed the empty control stick socket. But tug as he would, he could not move it. Again he attacked the bags, and had thrown half a dozen of them up through the tunnel, when suddenly the nose of the plane dropped, and the cabin started going round and round.

He leaped for the little trapdoor in the roof; but as he did so all of the sandbags he had thrown back into the gunner's tunnel came sliding down again and bumped him in the legs! He clung desperately to the whirling wing. The nose now pointed vertically downward, and the plane was spinning crazily.

The pilot pulled his legs through the hole, clung for a second, and then shot down into the cockpit. His head slammed against the rudder bar, his legs were around the stick. He seemed to have too many arms and legs for the narrow space he was in. But at last he got himself untangled. To straighten the rudder and put the control stick neutral was the work of a moment. The plane stopped spinning and went into a dive, from which it came out level not more than 500 feet above the ground!

"Phew!" whistled the pilot.

Perhaps, after all, he thought, he could land the thing as it was. There didn't seem to be anything else to do. If he tried again to throw those bags back the ship would only go into another spin, and back the bags would come. No use. Still, he would have to land with the motor almost full on, to keep the tail down. He thought of an old Royal Flying Corps term denoting high spirits. "Tails Up!" the boys used to say when they were feeling good. "Tails Up!" indeed. This plane must be a spirited creation, for it was certainly "Tails Up," for fair.

Now for it! He turned toward the course, throttled his motor as far as he dared, and went drifting down at a good seventy miles an hour. "Luck, stay by me!" he breathed.

Down he went. Just as the wheels touched he switched off to avoid fire, braced himself, and waited. He did not wait long. Up went the tail; into the ground went the nose. A graceful somersault, and the big ship landed on its back!

As the general manager, the chief engineer and mechanics rushed toward him, the pilot was loosening his belt. And as they reached the wreck he dropped from his upside-down position, his head and his hands thumping the ground. He scrambled out from beneath the plane, stood erect, found himself glaring into the frightened eyes of the general manager.

"Where's the idiot who tied that ballast in?" demanded the pilot. "Where is he?"

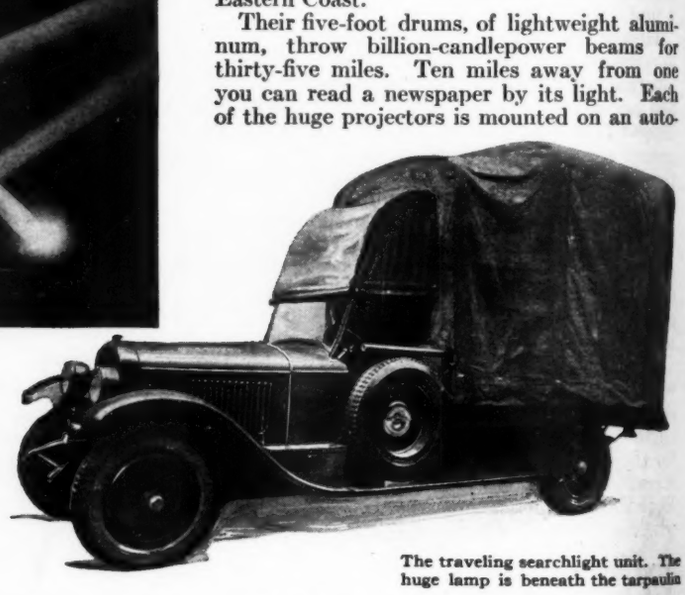
The general manager pointed at a small overall-clad figure disappearing across the field.

"There he goes. He's just resigning."

Huge Beacons on Wheels for Air Defense

NEW searchlights of tremendous power, yet lightweight enough to speed from place to place on their motor carriages, have recently been developed by the U. S. Army Engineer Corps as anti-aircraft equipment in wartime, and demonstrated on the Eastern Coast.

Their five-foot drums, of lightweight aluminum, throw billion-candlepower beams for thirty-five miles. Ten miles away from one you can read a newspaper by its light. Each of the huge projectors is mounted on an automobile chassis, and is readily unloaded by hand at its destination. A special motor that runs for hours without overheating turns the generator that furnishes electricity to the searchlight, and runs the automobile also.



The traveling searchlight unit. The huge lamp is beneath the tarpaulin

Top: A battery of new anti-aircraft searchlights in action at Baltimore, Md. Their billion-candle power beams extend for a distance of thirty-five miles in clear weather

Left: One of the sixty-inch searchlight drums ready for use. An electric cable leads to a motor car chassis which transports the light and generates the current

Near its source, the dazzling blue-white beam of the searchlight has the same intensity as the noonday sun. There is only one more powerful searchlight in the world—the 1,400,000,000 candlepower Sperry light recently perfected under Army supervision.

In war use, the motorized lights would be assembled at strategic points, ready to be rushed into service when listening devices warn of approaching air raiders.

Treasures from the Sky

Meteorites Crash to Earth with Gems, Precious Metals and Secrets That Have Been Applied in Industry

By NEIL M. CLARK

IT WAS a holiday and a citizen in Colby—a speck on the map in central Wisconsin boasting less than a thousand souls—had been celebrating well but none too wisely. Home now, he leaned against the door jamb to steady his legs a bit before going in to supper. His uncertain gaze drifted off to the north and there was caught by something moving in the sky.

It might have been a fire balloon, judging by the size. But no fire balloon ever dreamed of traveling half so fast.

"*Whoosh!*"

Hardly had the man seen it, when it shot past.

THERE came a tremendous explosion. Doors rocked, windows rattled, the very ground trembled. In a flash, the unsteady citizen remembered something: the country whose birthday he had been celebrating was at war; the enemy was rumored to possess guns that could shoot miles and miles.

"Run!" he yelled, galvanized into frantic action, "The Huns are shootin' up the town—they already pretty near got *me!*" For it was the Fourth of July, 1917, and we were at war.

It was, of course, no German shell, but one of those wanderers of space, a meteorite. It fell in two pieces, the smaller weighing eighty pounds, the larger 150. The latter landed inside the village limits with such momentum that it buried itself five feet in tough clay soil. Either piece would have been fully as fatal as a German shell for anybody in the way.

Photo by American Museum of Natural History

Famous 13-ton meteorite being removed from the Willamette Valley, Oregon. Levers, block and tackle were used in the unusual operation

Meteor Crater in Canyon Diablo, Arizona, where scientists expect to find meteorite containing platinum by digging 600 feet

Photograph by Field Museum of Natural History

Digging the 150-pound section of the Colby, Wis., meteorite, one of two pieces which drove five feet into the hard, rocky ground

Meteorites have a vast new significance. The other day a drill was broken 600 feet underground in a test boring in Canyon Diablo, Arizona. A simple accident. Yet scientists of several countries are wondering just why that drill broke. Furthermore, a group of practical mining men believe its breaking signifies that their fortunes are made—for they expect to find platinum in paying quantities at the 600-foot depth.

That is the latest chapter in the history of Coon Butte, or Meteor Crater, where it is believed a gigantic meteorite buried itself at some past time. The broken drill is the first positive indication that the main mass of the meteorite may have been located.

If actual mining, preparations for which are going forward, proves this to be the case, we shall have fresh evidence that truly we live in a hazardous and surprising world, since the very heavens can open and bombard us with "projectiles" weighing hundreds of thousands of tons. A meteorite such as that supposedly hidden under Meteor Crater could, if it dropped in the ocean, cause one of the most colossal tidal waves ever known; or, dropping on land, could devastate the fairest part of Chicago or New York, and kill thousands of people (perhaps hundreds of thousands) in the twinkling of an eye. There is no reason to suppose that such a catastrophe, if it happened once, could not happen again, sometime, somewhere. Indeed, late news from Africa indicates that it *has* happened at least one other time.

METEORITES have been fascinating and puzzling objects of conjecture for centuries, but hitherto they have always been of rather modest size. People have woven myths about them, and have worshipped them, but only recently have scientific men begun believing in them. When Thomas Jefferson was president of the United States, two Yale professors described a shower of stones observed at Weston, Connecticut. Hearing of it, the President remarked:

"They may be right; but it is easier for me to believe that two Yankee professors would lie!"

Dr. O. C. Farrington, Curator of Geology at the Field Museum of Natural History, responsible for the most representative collection of meteorites in existence and one of the greatest authorities on the subject, told me this story, and many more, while explaining the history of various meteorites behind the museum glass.

"Jefferson's attitude," Dr. Farrington

said, "was the usual scientific attitude up to almost the beginning of the Nineteenth Century. Today, of course, there is no room for disbelief, and meteorites are helping us to unfold chapters in the fascinating story of the universe, besides serving practical uses. Specimens are eagerly sought by museums and men of science for study, so that anybody who finds or can claim ownership in a genuine meteorite, can fairly count it as cash in his jeans!"

One of the most desired, yet most elusive, of these prizes is a lost meteorite of unusual size, which lies buried in the soil somewhere in Nevada. One autumn evening forty-five years ago, a group of miners loitering in a silver mining camp at Tuscarora, in the northern part of the state, were startled to see this visitor flash through the sky to earth. They were sure it landed in Nevada. Since then men have searched for it time and again, in vain. The latest searching party, headed by Dr. Chester A. Reeds, of the American Museum of Natural History, has just returned empty handed. Although this expedition set out in response to an apparently well-founded report that the meteorite lay buried in a haystack yard in Jackson Valley, Nevada, not a trace of it could be found. Dr. Reeds, however, plans to continue the quest. In the vicinity of Tuscarora, he points out, are many desert valleys, in any one of which the prize may be hidden.

A VIVID idea of how a large falling meteorite appears in the sky was given recently by a mining engineer who witnessed the display in Tuscarora in 1882:

"I was in the open and looked up and saw what seemed to me a coil of smoke of a peculiar color, much like molten gold. It was not in a straight line, but seemed to have convolutions. I was astonished at the sight and for a moment was unable to comprehend it. I did not see the meteor itself, but only the cloud left by its passage."

What, after all, are meteorites? Where do they come from? Are they the flying fragments of broken-up worlds? Were they, previous to their fatal collision with the earth, tiny "earths" themselves? Why do they bump into us as they do? Are we earth-dwellers in any danger because of them?

"A revised conception of space within the solar system," said Dr. Farrington, "is one result of attempts to answer these and kindred questions. We used to think of the earth traveling its orbit in solitude, its nearest neighbor the moon, a quarter of a million miles away. We know now that this idea is false.

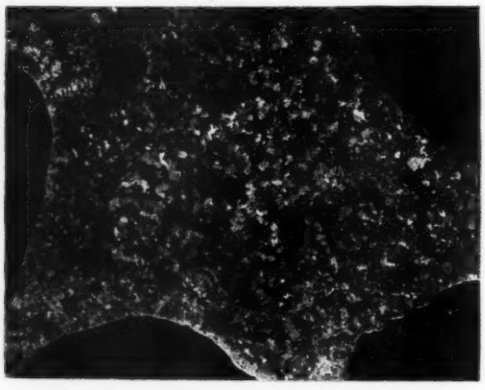
"Indeed, the earth actually might be compared to a man in a mosquito-infested swamp, so thick are the swarms of minute 'earths' through which we move. Only the surrounding atmosphere protects us from incessant pelting by particles of matter from the size of a pea upward.

"Most of these masses of matter are tiny, perhaps no bigger than a nut—'gnats' of space—and are consumed in the earth's atmosphere in brief trails of glory. We know them as shooting stars. It is estimated that at least *twenty million* of these particles flash out their existence in the earth's atmosphere daily.

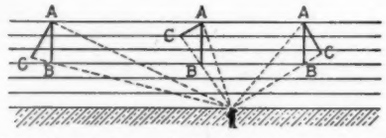
"There are other and far larger masses of matter, the asteroids, or planetoids, hundreds of which have been identified in recent years. The planetoids are like miniature planets, and probably vary in diameter from a few miles to a few hundred miles. None, so far as known, ever collided with the earth.

"Meteorites in size are midway between shooting stars and planetoids. Unlike planetoids, they do collide with the earth frequently; and, unlike shooting stars, they are too large to burn up before reaching the ground."

Some scientists assert that meteorites must be over-size shooting stars. Dr. Farrington doubts that. His reasons are convincing. August and November, he points out, are the months of greatest shooting-star activity, but May and June are the biggest months for meteorites.



A section of Willamette Valley meteorite, in the American Museum of Natural History, polished and etched to show its strange rock and metal formation



To the observer, indicated by the black figure, meteorites seem to fall as indicated by lines A-C. Lines A-B show actual path

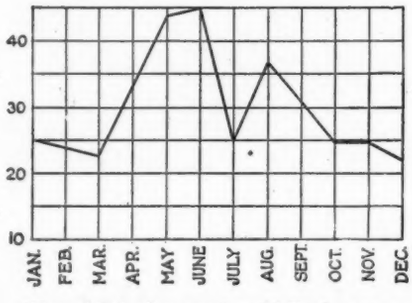


Chart showing how number of falls of meteorites varies from month to month, May and June being months of their greatest activity

Furthermore, a majority of meteorites fall in the afternoon, and between noon and midnight, whereas there is no indication of any falling-off in shooting-star activity after midnight. He thinks it more likely that meteorites are different in kind from shooting-stars, possibly the fragments of larger bodies, perhaps of disintegrating planetoids.

"But of course," he adds, "nobody knows."

Nobody is certain of the commonly accepted theory that meteorites are small parts of our own solar system, perhaps left over from fragments drawn from the sun when the planets were formed. One who recently has taken exception to this view is the Austrian geologist, Dr. Robert Schwinner of the Karl-Francis University at Graz. He suggests instead that the reason for their appearance is that our earth now is passing through a part of space where a vast heavenly catastrophe occurred millions of years ago, when two small stars collided. Our solar system, he says, is drifting now through the part of space strewn with fragments of the colliding stars. These fragments are meteorites.

Are meteoric collisions with the earth frequent? The number has been estimated by recording all known falls in a given area, like France, during a certain period, and from that computing the number for the whole earth, assuming that one place is as likely as another to be the scene of a meteorite's fall. It is supposed that about 900 meteorites fall yearly.

MOST of these are never seen or recovered. For one thing, three fourths of the earth's surface is under water, and a meteorite would as soon fall in the sea as on a crowded street—most of us would sooner it did! For another thing, many meteorites look like common stones and, unless seen to fall or examined by an expert, may never be identified. Many meteorites, too, fall with sufficient velocity to bury themselves, as the giant of Meteor Crater is supposed to have done. Furthermore, if the material is mostly iron, as it often is, a moist climate is likely to rust and disintegrate it.

By an actual count, 436 meteorites were *observed to fall* and reported between the years 1492 and 1921. The total of known falls, whether seen or found, is about 850.

"Meteorites not seen to fall," Dr. Farrington explained, "are identified by peculiarities in composition or structure, by the shape, the pitting on the surface, the crust (formed by fire while the mass hurtles through the earth's atmosphere), and occasionally by the presence of materials not found on the earth. An expert is not fooled by cinders or 'pock-marked' stones which people sometimes pick up and try to sell, thinking them real meteorites.

"Nickel-iron is specially common in the genuine meteorite, and modern industry has reason to be thankful for the fact. You see, museums slice up their specimens and distribute pieces, in order that a great many people may study them. A Philadelphia concern once had the task of slicing a nickel-iron meteorite, and found it very tough.

"'Why,' somebody suggested, 'wouldn't nickel-iron be equally tough if made in a furnace?'

"Experiments proved the idea sound. The result is not merely the nickel-steel used in industry, but also all the other alloy steels without which modern industry would be impossible: manganese steel, chrome steel, tungsten steel, and others.

"Diamonds have been found in meteorites; in fact, in those picked up in the neighborhood of Meteor Crater. It was a study of them (*Continued on page 176*)

New Flying Battleship

Huge All-Metal Biplane, Tested for Uncle Sam, Carries Six Guns and Four Tons of Deadly Bombs

NEW war terrors are forecast on this page in our artist's conception of the new giant bomber, the Curtiss "Condor," swooping down to destroy an industrial center. From its three two-gun nests machine gunners pour streams of bullets at enemy planes attacking from any direction, while the man at the bomb controls manipulates them to drop the explosives through an opening in the fuselage. With 90-foot wing spread and two 600-horsepower motors, the plane, which is all metal, weighs, loaded and manned, over eight tons, including four tons of bombs. In recent tests for War Department and Air Service officials, the huge plane took off in 200 feet and made 100 miles an hour, flying and landing gracefully. It carries 640 gallons of gasoline and has a cruising radius of 800 miles

Modern Magic in Light

"Music" Played by Colors, Statues Dance to Help Solve Problems of Illumination

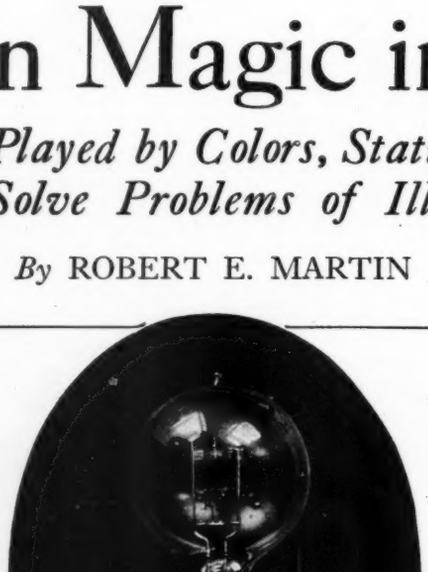
By ROBERT E. MARTIN

THE marvels of light from its crude yesterdays to its present brilliance, with a glimpse of future splendors that now seem quite incredible, are shown to visitors at a unique permanent exhibition. It is a museum and a laboratory with a factory adjacent. We see what has been, is and may be in the field of illumination.

Light used to be regarded as just something to see by. Here we find it is a force, a substance, an aesthetic material. Light is not immediately audible yet it will carry words and song. We used to think that the only virtue of light was to illuminate darkness; now we find there is more light in the dark than there is in the light. People have been "sunburned" in a dark room. They have been photographed without a speck of visible light.

Would you like to see the original incandescent lamp of 1878 which Thomas A. Edison gave the world? Here it is. Near by is a sample of red whisker—human hair—which the great inventor to whom we owe all modern illumination tried to convert into a filament. We see an interesting contrast in modernity. A giant lamp the size of a pumpkin and a dwarf the size of a pea. The big fellow uses 30,000 watts, emits 100,000 candlepower or ten times the sunlight in the Sahara desert, and costs two dollars an hour to operate. The little fellow uses about one sixth of a watt, emits one tenth candlepower and costs ten cents a year. Both are shortlived freaks compared with the average lamp that gives us one thousand hours of service.

WE ARE visiting the Edison Lighting Institute of the General Electric Company. Most of the basic scientific research for the concern is carried on elsewhere. Here at Harrison, New Jersey, is the place of practical application of discoveries, a free museum and a showroom without salesmen. Still the men here do originate many things in practical application. Take Henry Schroeder, whose history of electric light has been published by the Smithsonian Institution; A. L. Powell, virtuoso of eye music and expert in paint color values; Berthold Audsley, model maker and artist; L. C. Porter, who takes night flights in Government planes to see whether an airway is rightly beaconed. Imagine flying over your own lighting layout.



A 100,000 candlepower, pumpkin size, incandescent lamp, ten times sunlight, and below it a pinpoint lamp of one tenth candlepower. Upper left corner of this page: Five-girl crew feeding a machine that makes 2500 lamps a day. Upper right: Inside the photometer, the large sphere, are a standard lamp and a new one. The girl looking in compares their light to see if the new one is perfect

There is an auditorium with a stage and all sorts of weird and instructive shows. Someone flips a tumbler switch. With a slight buzz and clatter window curtains of the divided sort close and the auditorium becomes pitch dark. The stage curtains open and close in the same manner. It is all done simply enough by an electric motor above each opening. Automatic curtains are also used to shut off rooms which surround the Institute auditorium, neatly furnished to represent the average home, including living room, dining room, bedroom, kitchen and bath. Here a dozen ways of home lighting are demonstrated. We learn that the best general method is a center bowl which throws light against a white ceiling to be reflected downward. Of course auxiliary reading lamps and special local fixtures are also needed, while wall candelabra serve an ornamental purpose. There is a display of lamp shades. One is a curled porcelain fish whose green mouth spews foamy light through a cascade of translucent beads.

VISITORS are apt to regard the automatic curtains and other devices as amusing tricks. It is difficult at times to know whether we are witnessing a scientific demonstration or merely a funny stunt. A galloping flivver that shivers over a bumpy road is one of a series of light illusions. A dancer performs with grace and vigor. She is a plaster statue and all the dancing is done by the light that frolics over her. Then there is an oil painting of a ship at sea. Suddenly the ship is replaced by a tugboat. Nothing has been changed in the picture, but a different color of light has blotted out the large craft and revealed the small one.

Eye music is played on the fluted folds of the gray stage curtain. The tones, derived from the spectrum, red to violet, glow and fade, blend and dissolve harmoniously one into another, make us sad and glad, dreamy and excited. Peaceful blue drifts into a romantic moonlight, which becomes luxurious purple, leading imperceptibly to an active yellow and

then to a trumpeting martial red. The eye music is accompanied with appropriate ear music of opera or symphony orchestra.

The instrument of the new art is a color organ. It is a medium sized box with eight lever handles of rheostats to increase and diminish light. The colors are in the individually colored lamps of the footlights and overhead lights of the auditorium stage, which, unseen by the audience, cast their glows on the curtain. It is a surprise to find that the individual lamp colors are simply red, blue, green and amber. Powell improvises, making eye music according to the inspiration of the moment. His music is not written. Perhaps some day a Bach of eye music will devise a recording system and compose works that others may play on their own light organs.

Five lighting systems are shown in the auditorium—direct, enclosing globe, semi-indirect, totally indirect and totally indirect with luminous bowl. All are in bowls. If you wish to see the glare of unshaded light—a primitive method which will be abolished before long—there is an example in the industrial room—a direct glare. Click! buzz!—The same light in a frosted bulb gently diffuses illumination. Does the color of walls and ceiling make much difference in lighting? Watch!

The white panels of this room are reversed, showing their slate-colored backs. The light is the same but fifteen percent of it is wasted, absorbed by the slate color. Very dark walls steal half to three-quarters of all the light. The moral is that paint is cheaper than electricity and light wall paper will cut down the monthly bill for current.

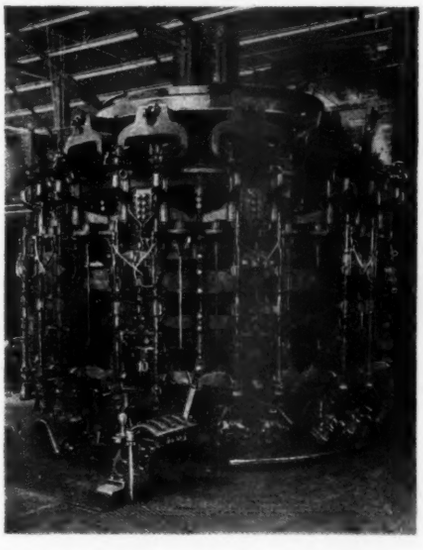
Miniature street, 20 feet long, used to solve problems of municipal lighting. Three miles of wiring and 175 switches—some of them seen in the foreground—operate various street and building lights

IN various rooms are globes, two to seven feet in diameter, made of metal in flanged sections. Each has a curved hinged door besides other attachments. These globes are photometers, for measuring light. They are white inside, to reflect all the light of a lamp placed within. They are spherical in shape because light spreads equally in all directions from a central source and we want to measure the total output of a lamp. The smallest sphere of two feet diameter has at its center a tiny lamp of one candlepower intensity. This is the basic unit of light. Each inside square foot of the sphere receives an intensity of one foot-candle or an amount that is termed one lumen. There are 12.57 square feet of internal area, so the total output is 12.57 foot-candles in intensity and the same number of lumens in amount.

Since the ordinary home lamp of forty watts yields about ten lumens per watt, its total output is 400 lumens or over thirty times that of the basic candlepower lamp—probably sixty times that of the actual tallow candle used by our ancestors.

Let us look into the eyepiece of a photometer and test our skill as a judge of light values. A pink dot appears in the center of a large glow. We turn a thumb screw until we fade out the pink dot and produce a uniform brightness. Now glance at this lumen scale. We have done well for a first attempt—only four percent error. But if the eye is the judge, will not even the expert's eye occasionally bring in a false verdict? Yes. Science has lately met and overcome this criticism. Here we have a square box the size of a large camera. It contains a mechanical eye which looks inside the photometer sphere and makes an unbiased, 100 percent correct report. Yes, it is a photo-electric cell, the marvelous device that gives us talking pictures and television.

Somebody says that while the modern lamp is sixty times better than the tallow candle, it is sixty times lower in efficiency than the firefly's lantern. Is that so? Yes, roughly. And is the difference accounted for by the loss of energy in heat in the case of the electric lamp? No, the heat loss is small compared with the loss of invisible rays emitted at both ends of the spectrum. In vacuum lamps only eight percent and in gas-filled lamps twenty-five percent of energy is dissipated as heat. Most of the power escapes in below-red and above-violet unseen rays, leaving us a small fraction of useful illumination.



Mechanical fingers at the top of this revolving turret pick lumps of molten glass from the furnace and drop them into compartments that blow them into lamp bulbs as they cool. The capacity of the machine is 64,000 lamp bulbs every twenty-four hours

White light is a mistake from the efficiency standpoint. It has a theoretical maximum of 265 lumens per watt. Yellow-green light, used by the firefly and other wise insects, is good for 620 lumens per watt. Compare with this our ordinary achievement of ten lumens—or twenty for high power lamps—per watt. The white light or so-called optical efficiency of the average lamp is six to eight percent, but compared with the insect yellow-green output it is less than two percent.

We may note that gas-filled lamps, while wasting much more energy as heat than the vacuum type, surpass the latter in illumination, because the higher temperature of filament permitted by gas-filling results in a greater output of visible rays.

LET us rest our figure-laden minds with a visit to the model room where a toy house is being furnished and painted, a knee-high locomotive stands ready to go under 200 pounds steam pressure, and the turn of a switch illuminates a multitude of thumb-size saints in the stained glass window of a miniature cathedral. The amiable toy artist is Audsley. He made that cathedral entirely with a pocket-knife. Not long ago he built a 400-pound electric locomotive in his home attic. It took some engineering to bring that model down the attic stairs.

Such toys, capable of real performance, serve a wider purpose than entertainment. They may be used for tests of principles, designs and materials. All kinds of new lighting schemes may be experimented with in a tiny cathedral or house.

Perhaps the most intriguing model reproduces an American street. There are skyscrapers fully two feet in height, shops with plate glass windows, a movie palace with winking colored lights, familiar signs of commerce. Flip! Tall street lamps glow. Flip! Shop windows light up. The moderate illumination of the average small city. But the city hall remains in gloomy dimness. Flip! Its cornices glow with screened radiance that reveals the architectural outlines and accents the stately pillars. This model demonstrates all kinds of street lighting and shop lighting with the relations between the two. What almost any city has and might have may be vividly illustrated.

We are surprised to learn that the famous White Way or theatrical section of Broadway, New York, is not the world's best lighted (*Continued on page 165*)

Inventions Speed Up Modern Football

Through boxlike hurdles Northwestern University football men run to learn accurate footwork. At right: Football shoe with new long bakelite cleats for wet fields. These can be replaced with the short ones (below) on dry fields

A University of Washington football player comparing weights of the old equipment and the new, invented by Coach Bagshaw. Foam rubber replaces the fiber padding formerly used. The new "armor" weighs but seven pounds, ten pounds less than the old style outfit

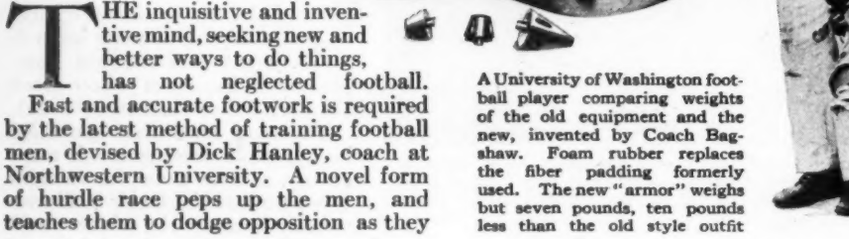
THE inquisitive and inventive mind, seeking new and better ways to do things, has not neglected football. Fast and accurate footwork is required by the latest method of training football men, devised by Dick Hanley, coach at Northwestern University. A novel form of hurdle race peps up the men, and teaches them to dodge opposition as they race for a touchdown. Tacklers have no terrors for them after they have learned to leap through boxlike barriers.

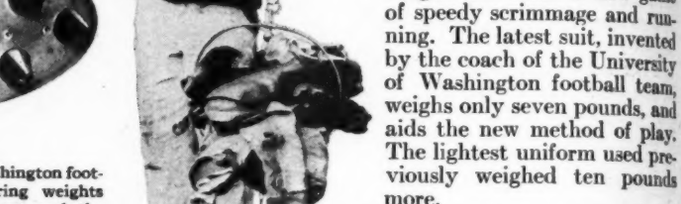
Adjustable football cleats of bakelite are among science's new contributions to this sport. Unlike the usual cleats of leather, they do not soak up water on a wet field.

Gone are the old Rugby players, with savage chrysanthemum hair-cuts, carrying some thirty pounds of armor. From the old game of heavy weight has come a new game of speedy scrimmage and running. The latest suit, invented by the coach of the University of Washington football team, weighs only seven pounds, and aids the new method of play. The lightest uniform used previously weighed ten pounds more.

The reduced weight has been achieved by the substitution of foam rubber for the fiber padding previously employed. The new uniforms protect the players as much as the old, and are much faster.

Dryer Makes Hay While It Rains!





Above: The new harvester automatically loading a motor truck. At left: The dryer carries alfalfa on an endless belt through a hot air furnace. It is dry in 30 minutes

HAY-MAKING in the rain is a daily miracle with a new drying and curing process invented by Arthur Mason, of Chicago. His extraordinary machine, he says, makes it safe and profitable to grow alfalfa in the rainiest sections of the country. Let it pour; the green, wet alfalfa goes into the device at one end, and from the other comes dried alfalfa meal.

This revolutionary process, it is said, saves all the tender leaves that are richest in protein; the product contains one fourth more of this valued ingredient for cattle food than sun-cured hay. It may make possible a saving of millions of dollars to farmers in the South and East who now order supplies of rich cattle food from distant regions. With this device they could make their own.

The unique artificial dryer cures oat hay, alfalfa, clover, and soy beans. Its one-hour process, the inventor claims, results in a richer product than two days or longer of sun drying. Since it allows these forage plants to be cut earlier than for natural drying, it often permits two crops a year instead of one.

Alfalfa to be dried is cut and formed by the machine into a mat eight inches thick. As told in POPULAR SCIENCE MONTHLY at the time of the first experiments with the new process, this mat passes on an endless belt through a hot air furnace 150 feet long. It is dry in thirty minutes. Then the alfalfa is ground into meal, and conveyed by an air blast into the barn or into sacks without handling. Sixty minutes is all that is required to transform the living plant in the field to dried meal in the barn.

The Modern "*Iceman*" Arrives

Intricate Tests Show Remarkable Efficiency of New Refrigerators—How to Select the Right One

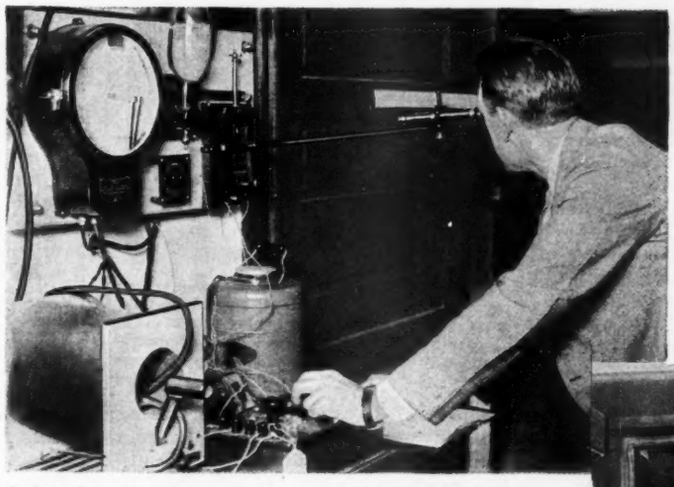
By PROFESSOR COLLINS P. BLISS
Director, Popular Science Institute of Standards

COME with me to the Sage Research Laboratories of New York University and I will show you how temperature is made to order in a remarkable new laboratory.

This unique place was designed with but one object in view—to find out all there is to know about iceless refrigerators. It was built by the Popular Science Institute of Standards in coöperation with New York University that you might have accurate and unbiased guidance in the selection of a refrigeration system.

A strange room is the constant temperature chamber, the key-point of the tests in this laboratory. Outwardly much like any other room, it really is a gigantic icebox. Walls of eight-inch hollow tile lined with six-inch solid cork. A roof of wood lined with cork and a cement floor covered with a five-inch layer of cork topped with cement and cork tiling. Around the inside walls are coils of pipe connected with the commercial refrigerating plant in an adjoining room.

Here elaborate tests, now going on, will provide definite and accurate answers to any questions you may ask about iceless refrigerators, their operation and relative efficiency as compared with ordinary iceboxes.



At intervals the temperatures inside the constant temperature room and in each food chamber of the icebox under test are checked with an electric thermometer accurate to a thousandth of a degree. The tiny thermocouples used can be placed at any point desired so as not to interfere with the test in any way

OF COURSE, the simplest way to test any refrigerator is to install it in a kitchen and judge it by results obtained in actual service, but with every mail bringing an increasing number of requests for specific information, that isn't practicable. And so our investigations, unlike anything ever before attempted by a magazine, were begun.

By means of a thermo-control system and electric space heaters, a refrigerator under test in our constant-temperature chamber can be kept surrounded with air at any desired temperature from zero to 120 degrees for weeks at a time. And our regulation of the testing equipment is so close that the temperatures will not vary from the desired point more than one half of a degree. We can approximate the conditions in an overheated kitchen in midsummer or on a wind-swept porch in midwinter, as we like.

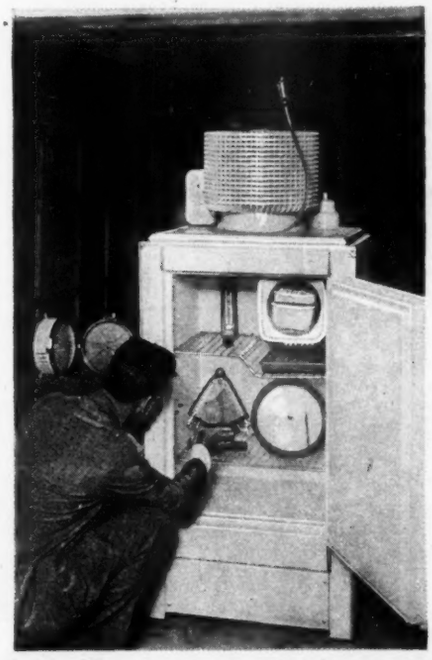
Humidity—important in gaging refrigerator efficiency, because humid air transmits more heat into a refrigerator than does dry air at the same temperature—is measured with delicate and precise scientific instruments. And, as a final check on temperatures, we are able by means of amazingly accurate instruments to test the temperature at any point inside or outside the refrigerator, to within a thousandth of a degree.

Since a refrigerator is called on to give satisfactory results under many conditions, there has been duplicated in our laboratories every reasonable combination of conditions the refrigerator may encounter, and each refrigerator tested is put through these conditions not once but again and again, that the results may be directly compared.

The value of any icebox or iceless refrigerator is primarily determined in the Institute by its ability to maintain a temperature inside the box of not more than fifty degrees Fahrenheit, no matter what the temperature is outside the box, and by the cost of obtaining this result. Almost any refrigerator, iceless or of the icebox type, will be able to hold the inside temperature ten degrees below the outside temperature. But when the mercury outside hovers around the ninety mark, many refrigerators begin to fall down on their jobs and food is spoiled.

Many factors affect the costs of operation. One householder, for example, may keep the refrigerator in a hot kitchen. Another may place it in an

Preparing an iceless refrigerator for test in constant temperature room. Note recording thermometer being placed in food compartment and frost on the cooling coil near the door



Iceless refrigerators give dry cold for preservation of food. This refrigerator is being arranged for test to determine dampness left in box after hours of use

unheated pantry or vestibule. Food may be cooled to room temperature before being placed in the food compartments, or servants may leave doors standing open for long periods and put hot food into the refrigerator. Since these factors cannot be accurately determined, the tests at the Institute assume average conditions as nearly as possible.

Service expense and the life of the iceless refrigerator all enter into cost. Modern iceless refrigerators should last for at least ten years, and even at the end of that time the cooling unit will be the only part that will need a general overhauling or replacement. Service costs, as shown by the experience of many users, run approximately to $15 a year and consist, mainly, of repairs to the thermostatic control and belt drive.

THE tests already completed indicate the immense advantages of iceless refrigeration.

Chief among these is the steady cold maintained within the food compartments. With an ordinary icebox—even a very good one—the temperature begins to rise when the lump of ice melts down to smaller size, as it is bound to do over the week-end because the iceman ordinarily does not deliver on Sunday.

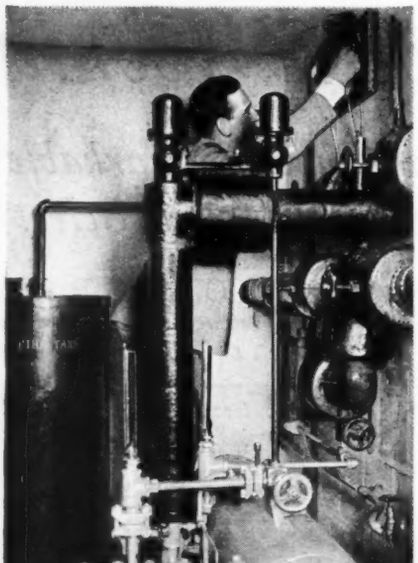
Experts on food preservation have found that fifty degrees is the critical temperature. Food of all kinds that is kept at or below this figure will be kept in good condition, whereas if the temperature rises even so much as two or three degrees above fifty the food starts to deteriorate very rapidly. Bacteria multiply by the millions. Meat acquires a peculiar taste and a bad odor. Milk sours. Fruit begins to ferment or becomes covered with mould. All these things begin to happen in an ordinary icebox if the iceman fails to show up.

All good iceless refrigerators are adjusted to keep the temperature at not over fifty degrees.

This temperature is maintained day and night even if you should go away for a week, leaving the house locked up. On your return you would find the food in the iceless refrigerator still in perfect condition provided, of course, that it was fresh when first placed in the compartments.

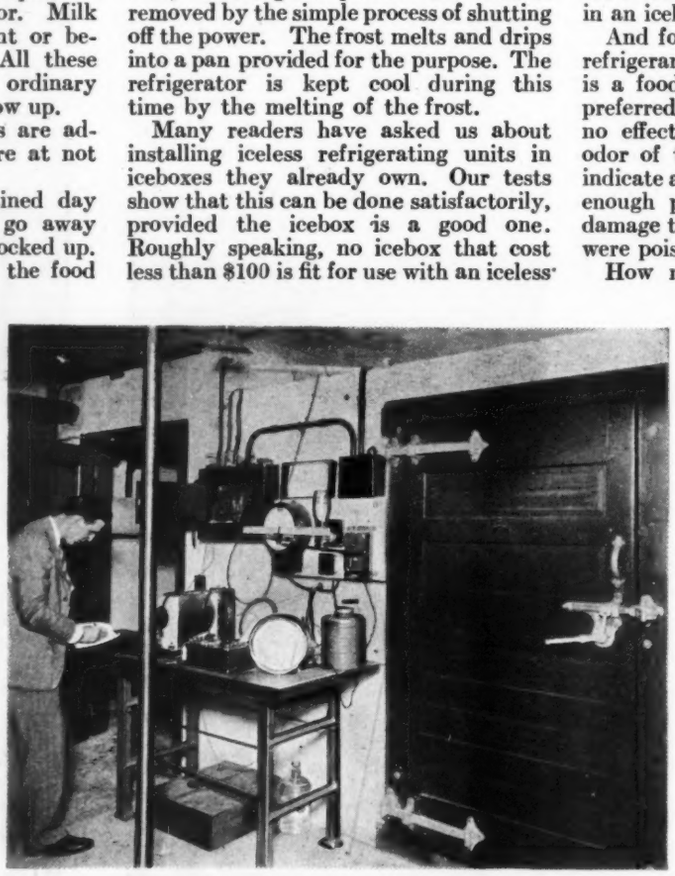
Another advantage is the fact that with an iceless refrigerator you can produce many sorts of delicious frozen desserts. You can't do that with an ordinary icebox. Then, the iceless refrigerator will manufacture ice in handy cube form for use in cooling drinks. Ice made in your own iceless refrigerator is certain to be just as pure as the drinking water supply. You can't always be sure of equal cleanliness from ice bought outside. A common trouble with the ordinary icebox is a clogged drain with water flowing over the floor as a result. An iceless refrigerator has no drain.

In iceless refrigerators the air in the food compartments always is drier than the air in an icebox. In fact, the refrigerating unit is constantly removing moisture from the air in the box and turning it into frost which collects on the refrigerating coils or tank. In time, this layer of frost would become so thick as to impair seriously the efficiency of the refrigerating unit, so at regular periods the frost is removed by the simple process of shutting off the power. The frost melts and drips into a pan provided for the purpose. The refrigerator is kept cool during this time by the melting of the frost.



The commercial type refrigerating plant that is used to control the temperature in the constant temperature room. The thermostat is far more delicate and accurate than would be needed in the commercial installations for which this apparatus is designed

Many readers have asked us about installing iceless refrigerating units in iceboxes they already own. Our tests show that this can be done satisfactorily, provided the icebox is a good one. Roughly speaking, no icebox that cost less than $100 is fit for use with an iceless refrigerating unit. You may be getting along reasonably well with such a box merely because you do not expect very much in the way of results. A cheap box, even when filled with ice, will not hold the correct food preserving temperature. An iceless refrigerating unit installed in such a box will run up a staggering electric or gas bill trying to maintain the proper temperature in spite of the poor insulation of the box.



At the right is the heavy, heat-insulated door of the constant temperature room in which iceless refrigerators are tested. All control instruments are located outside the room. Test conditions may be changed and the results that occur inside may be noted without opening the door

NOW, as to the possible disadvantages of iceless refrigerators. One of the most often quoted is that ice produced in an iceless refrigerator has a queer taste. Our tests show this to be ridiculous. Ice made from your drinking water must necessarily be of the same quality, and merely subtracting the heat from the water so that it turns into ice isn't going to affect its purity or its taste.

We believe, too, that generally speaking, any good iceless refrigerator is more reliable than a new automobile. Parts do break at times, but the service man is available to take care of that, and the few hours lost for repairs or because of power failure are exceptions rather than rules. In such cases, the reserve heat absorbing capacity of the iceless unit will keep the box cold until the service man gets things going again.

Fire hazard has been charged against iceless refrigerators. This possibility is extremely remote. The refrigerant most generally used, sulphur dioxide, is unburnable, and the others, such as methyl chloride, ethyl chloride and iso butane, are inflammable only under a particular set of conditions that could hardly arise in an iceless refrigerator.

And food contamination from leaking refrigerant isn't possible. Sulphur dioxide is a food preservative, although not a preferred one, and the others would have no effect whatever. In any case, the odor of the escaping refrigerant would indicate a leak long before there could be enough present in the refrigerator to damage the food, even if the refrigerant were poisonous.

How noisy are iceless refrigerators? That is a question which will be answered with great precision by the tests now going on at the Popular Science Institute of Standards. Of course, no two people are likely to agree as to what constitutes objectionable noise.

I recall visiting friends who had lived for years in a suburban community, near the railroad. Every few minutes, so it seemed, a long freight train would go by making such a thundering noise that conversation was difficult. The hostess sat for some time in an attitude of strained listening and then while one of those trains was passing, she suddenly said:

"There! Did you hear it? That noisy icebox just started up again!"

That particular iceless refrigerator made about as much noise as an electric fan! How she heard it at all through the noise of the train is a mystery.

They're Creating *a New* World

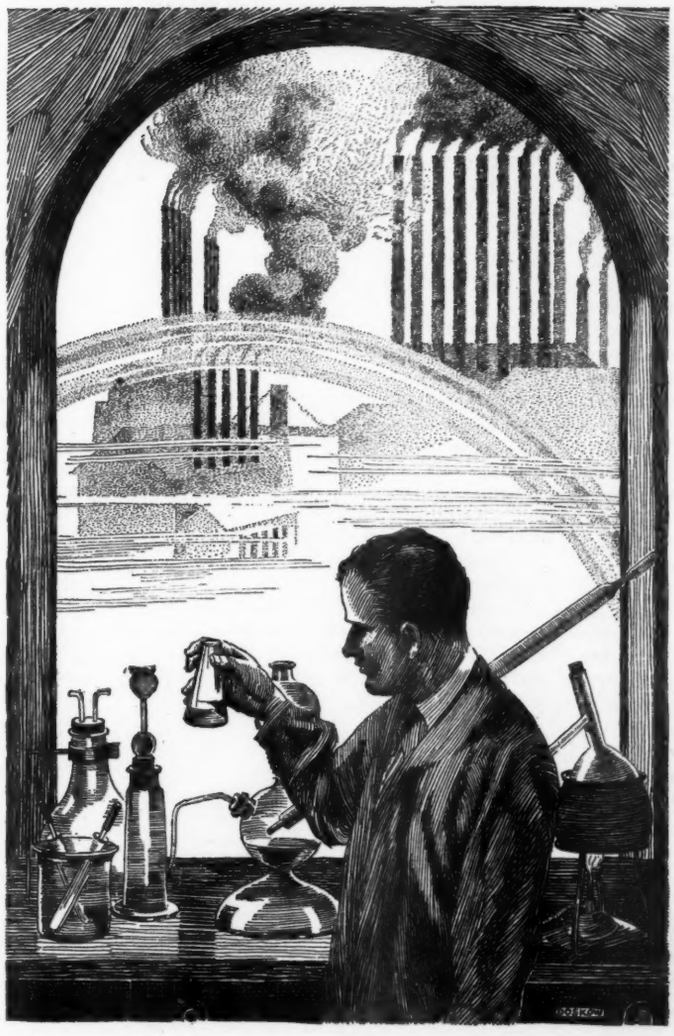
Magicians of Chemistry, Juggling Atoms, Are Wresting Secrets from Nature to Satisfy Countless Modern Needs

By LOUIS E. VAN NORMAN

A CONVERSATION with the great German pathologist, Koch, years ago, is one of the bright spots in my memory. One of his remarks will always remain vivid. "It is not the conquest of nature, not the imitation of nature, which is the whole duty of man," he said. "We must overcome nature, or, rather, harness her—improve upon her. That way, only, can we rise."

"Back to nature"—yes, for simplicity and healthfulness. But not by any means "back to nature" for methods of scientific advance. It is by science that the world has been made habitable. By chemistry, particularly, a decent human life has become possible on this planet.

Do you recall the pictures of chemists of the Middle Ages—with test tubes, retorts, and all sorts of other mysterious paraphernalia? Bad smells and weird-looking liquids, with—often—uncanny sounds, were thought to be inseparable from the chemist's laboratory. As a matter of fact, chemistry is so much broader and bigger than anything we can see or hear or feel or taste or smell, that it would be difficult to imprison it in a definition.



How the chemist and his retorts are accomplishing new marvels for modern industry is told in this article by a Commercial Attache of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce

THE speculative chemists are quite revolutionizing our ideas of the universe. As they tear apart matter and build it up again in other forms, we are dazzled by the romances and the riddles of creation.

But, after all, there is no mystery about chemistry. It is simply science reduced to an application to everyday life and things. Given the raw materials—the atoms—the chemist can nearly always find a way to make new combinations after the general pattern of the natural combinations, but without the faults which have been noted by man's trained eye. The chemist is a sort of architect whose building materials are atoms, little units that even the microscope cannot always see.

Perhaps the investor may think he has no concern in the work of the industrial chemist. But the security of principal is the basis of sound investment, isn't it? If the principal is not safe, then certainly profit cannot be expected.

Today no industry is safe without the services of the chemist, and the resources of his laboratory. Eternal search is the price of survival. The world is so full of people that we must keep on producing goods at ever decreasing cost. If yesterday belonged to the mechanical engineer, today and, even more, tomorrow, belong to the chemical engineer.

Without heat, light and power our modern civilization would be quite impossible. Electricity is at the base of all three. But the chemist makes the electric current available at a cost we can all pay. The last dollar possible must be wrung out of every pound of coal. The chemist does it.

Then we have all sorts of other things, such as explosives, dyes, medicines, motor fuels, road-making materials, perfumes. Not even the chemist himself can say how many more. He is still on the job of utilizing the by-products of coal, of oil, and of all the other major outpourings of nature.

The chemist is revolutionizing industry, turning it inside out, scrapping flourishing industries overnight and reviving decadent ones and building new ones.

Within the last few years, the chemist has learned to make artificial silk, artificial rubber, artificial dyes. He has actually created many things that, until he summoned them from the unknown, had never existed at all.

The chemist by simplification and standardization helps get rid of waste. "Cut down the production cost"—that is the cry he hears continually. One chemist said recently that when he failed to save his concern (a relatively small one) at least $200,000 a year, he began to "feel uneasy about his job."

THE chemist is not, primarily, an analyzer but a synthesizer, a builder. Not only must he discover things; he must know how to build these new things into new forms, so as to make a commercial profit possible. That is where the Germans used to excel. They are not primarily discoverers. They are technologists. They were masters in taking what the French, the English, Italians and others discovered and making it commercially profitable.

"How do we Americans stand in the world's chemical production?" I asked Mr. Delahanty of the Chemical Division of the Bureau of Foreign and Domestic Commerce. He laughed as he replied, "Today the United States is supreme in the world's chemical production. American plants are turning out one third of the world's output—more than the production of Germany and France combined."

Whole volumes would be needed to chronicle what the industrial chemist has already done for the iron and steel industries with the *(Continued on page 178)*

Science Gains New Ground

Ants Operate Farms—Brain Examinations Promise Future Age of Superman—Other Strange Discoveries

Discoveries and productions in many scientific fields that have bearing and influence on everyday life are chronicled from month to month in these pages.

Modern Pace Takes Its Toll

TODAY'S complex life is relegating more and more persons to the hospitals, Dr. G. B. Smith, neuropsychiatrist, recently told the American Medical Association. Body and mind, long thought of as separate, are closely connected, modern research in mental hygiene has shown; and up-to-date medical treatment must take into account the emotional conflicts caused by this complicated age. Another physician, Dr. C. C. Wholey, pointed out ways encountered in general practice that nature exacts its penalty for fast or complex living—such as paresis or partial paralysis; dementia praecox, a form of insanity; chronic anxiety, and other mental afflictions that may follow nervous and physical exhaustion.

Footprints Millenniums Old

THROUGH the telescope, visitors to the Grand Canyon of the Colorado soon will be allowed to peer into the mists of past ages, when strange monsters roamed the land. An observatory, it is announced, is to be established on the Canyon's edge, where sightseers may gain close-up views of geological discoveries in the depths of the great gully.

Among the latest discoveries are fossilized footprints left by prehistoric reptiles and amphibians that lived before the time of the great dinosaurs—as long ago, perhaps, as 300 million years! They were found in a layer of sandstone 1,800 feet down by Charles W. Gilmore, curator of vertebrate paleontology of the National Museum in Washington. One set of the tracks reveals impressions of sharp claws and marks of a dragging tail. "Possibly some reptile with bird-like claws and lizard tail," Gilmore explains. Other tracks resemble those of a huge rat which apparently was being pursued by a larger creature with crooked claws.

Gilmore has found more than thirty types of the prehistoric footprints.

Ants Practice Agriculture

GARDENERS of the insect world have their pumpkin patches and weed their gardens. Jean Bathellier, French naturalist, recently described his observations of white ants of Indo-China raising microscopic pumpkin-like pellets—a kind of fungus, somewhat like the mold on stale bread. The ants prepare a bed of fragments of leaves and grass. These they chew into a fine material, in which they plant the germs of fungus.

Fastest Top in the World

THE fastest speed of rotation ever known in a mechanical device has been attained by two French scientists with a new centrifuge, or whirling machine. Speeds have been measured up to 15,000 revolutions a second. The inventors say 1,000,000 revolutions a minute is possible.

Its rotation is twenty-two to thirty times faster than any before achieved. Elimination of bearings, and support of the rotor, or whirling part, entirely on air make the speed possible. In the photograph below, the "top" is in the inventor's fingers. It fits into the metal cylinder above, which is then closed by a corrugated cone on which the rotor rests. Compressed air, forced into the cylinder, whirls the rotor.

A lump of lead placed in the rotating chamber disappeared after several minutes. The centrifugal force had torn the metal to shreds and plastered it on the walls of the rotor!

The little rotor, or scientific top. It fits into the suspended cylinder shown in the upper picture, and is whirled by air under pressure

Bottom of Sea Yields Oil

WHEN the wells run dry, we may get our necessary oil supply from the bottom of the sea.

Today, off the coasts of southern California and of North Carolina, samples of mud and sand are being taken and distilled to determine their oil-producing capacity. In charge of these remarkable experiments is Dr. Parker D. Trask, research associate of the American Petroleum Institute, carrying on his researches with the aid of the John D. Rockefeller Fund of the Institute.

Geologists long have known that the source beds of most of our oil fields are marine in origin, deposited millions of years ago. Through the ages oil of these sea deposits was concentrated into pools which are now being drained.

This being the case, Dr. Trask argued, why may not the bed of the ocean be a source of future oil supply? And he set about answering his own question.

His tests of the ocean material thus far have shown that all types of sediment, from clay to sand, produce oil in some quantities after distillation. The amount of oil obtained ranges from nearly three gallons from a ton of clay-silt, to almost nothing from sand. The greatest yield so far obtained is only five to ten percent of the amount derived from high grade oil shale, which runs sometimes as high as fifty gallons a ton.

That there are possibilities of profit, however, is indicated by the fact that Dr. Trask is continuing his unusual investigations. The problem with oil involves the cost of production and refining. If sea soil can be found that yields a sufficiently high ratio of oil, and if the expense of extracting it is sufficiently low, a situation may develop that will revolutionize the industry.

Dr. E. A. Harrington in the U.S. Bureau of Standards, is seen testing a pyrometer or fire measurer, used in industry for determining heat greater than 1,500 degrees, Fahrenheit. Subjected to intense heat in comparison with a standard pyrometer, the device is studied to see if it corresponds in its tiny fractions of degrees with the instrument that is known to be accurate. Under the microscope, variations are detected that the naked eye could not see

in Many Fields of Research

Looking into a Volcano

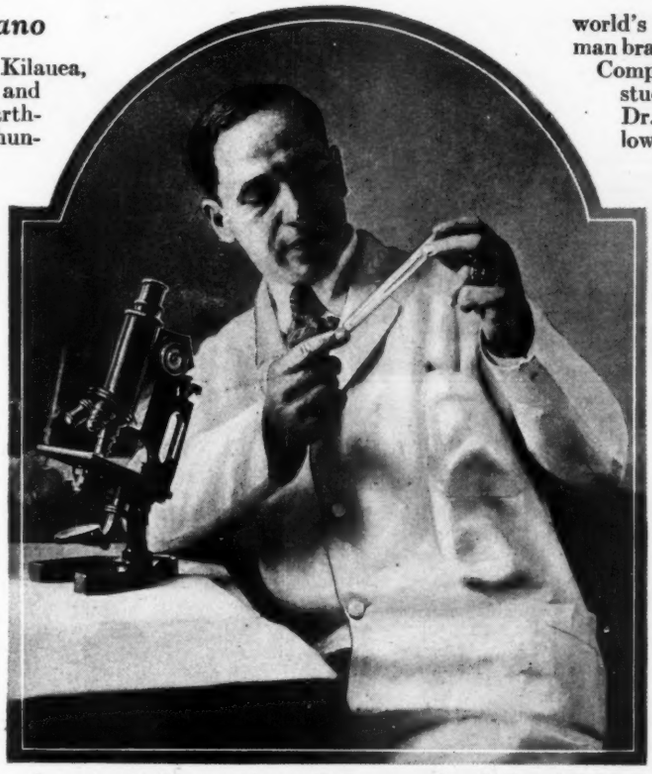
THE Hawaiian volcano, Kilauea, awakens after three years and spouts boiling lava. A terrific earthquake rocks Palestine, killing hundreds. One after another come upheavals that rock the earth.

What are the reasons?

On the very rim of angry Kilauea's crater stands an observatory where American geologists look down into the seething pit to learn the answer. In Alaska other geologists are planning similar observatories for the study of volcanoes and earth tremors. These investigations are under the direction of Dr. T. A. Jaggar, chief volcanologist of the U. S. Geological Survey.

While volcanoes still remain largely a mystery, observers are constantly learning new facts about them. They know now, for example, that they are not spouts for the release of liquid fire from deep in the earth, as was once the general belief, but rather are "test tubes for cosmic chemistry," in which the boiling lava is actually hotter at the top than it is deep down.

Eventually, perhaps, men may learn to harness the fury of these chemical test tubes and turn it to use, as they have done with other works of nature and natural phenomena, such as waterfalls, by which electric power is produced.



A step toward discovery of a specific for prevention of tuberculosis has been accomplished by Dr. Frederick Eberson, University of California Medical School, shown here at his microscope. He has discovered that the tuberculosis bacillus produces a definite toxin or poison. Now the problem is to find an anti-toxin that will counteract this poison

Predicts Race of Supermen

A FUTURE race of supermen, so often pictured in fiction, is far more than mere fancy, a strong probability, judging from evidence recently obtained by Dr. Frederick Tilney, professor of neurology at Columbia University, one of the world's foremost authorities on the human brain and its development.

Completing the first comparative racial study of the brains of apes and men, Dr. Tilney has arrived at the following conclusions:

Man unquestionably is descended from an ape-like creature capable of producing both apes and men.

The human brain today is still in process of development, and in all probability is only the forerunner of the perfect brain.

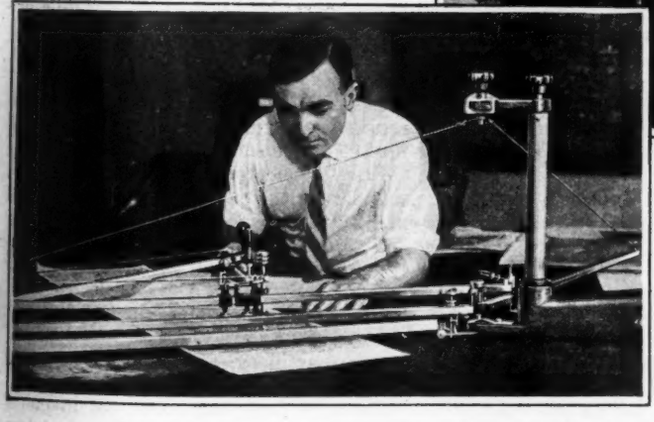
These findings are based on examination of fossils of human beings who lived hundreds of thousands of years ago, and comparisons with apes and modern men. The study was made at request of Prof. Henry Fairfield Osborn, head of the American Museum of Natural History. Its results seemingly contradict the recent statement of Professor Osborn that the forerunners of modern men developed independently of the apes and from some prehistoric animal not yet discovered. This statement, in a recent issue of POPULAR SCIENCE MONTHLY, aroused wide controversy among students of evolution.

By comparison of prehistoric brains, Dr. Tilney says he found unmistakable signs of progressive development.

"When the brains of all the prehistoric men we know are placed side by side there is not a question of a doubt about this progress. From one age to another and from one race to the next, man has shown a steady gain in his power to control material conditions."

As for instincts, Dr. Tilney's investigations indicated modern man has not progressed beyond the Neanderthal man, who lived more than 100,000 years ago. While primitive warring instincts have remained uncurbed, man's inventive genius has gained so rapidly as to threaten self-annihilation.

Models of steamships are being effectively used by the U. S. Public Health Service in its campaign of rational rat-proofing of vessels, which aims to obtain construction which offers rats no place in which they may nest and breed. The illustration shows an inspector pointing out a possible rat nest on top of a refrigerator in the galley or kitchen. The campaign has shown results on new and reconstructed ships

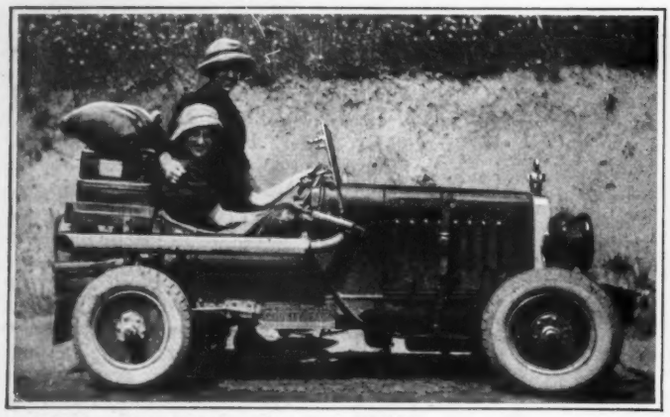


Preparation of the first "map of the air" for aviators issued by the U. S. Chamber of Commerce is shown here. It shows various currents, strata and danger areas. J. T. Fitzgerald is operating an ingenious device—a pantagraph with many geometrical complications—used in making the tracings, which must be of perfect accuracy. These maps, designed primarily for commercial aviators, will be issued at intervals as new data are obtained and are expected to aid largely in development of domestic air navigation

Braving Arctic for Science

IN THE hope of making the ocean airways safe for trans-Atlantic flyers, two men plan this year to record weather observations in Greenland. They are Prof. J. E. Church, director of the Mount Rose observatory, Nevada, and P. C. Oscanyon, New York radio operator. Their adventure is sponsored by Dr. W. C. Hobbs of the University of Michigan, who holds that Atlantic storms originate above the Greenland ice cap.

Manufactures Half-Size Autos



Off for a cross country run in a pygmy roadster which can speed a mile a minute and averages better than forty miles to a gallon of gas

The truck tire, shown for comparison, contains material enough for all the tires of this tiny coupé. Note elaborate shock absorbers

YOU may have to double up to get inside one of these half-size automobiles—but they're real cars, for all that. Proprietor of what is said to be the only business of its kind in the world, Jack Landon of Los Angeles, Calif., makes midget cars exclusively. They are said to rival standard machines in speed, endurance, and luxurious appointments—and they are just as high-priced.

Every detail, from the diminutive chassis to the controls, is scaled down to fit the tiny cars—with the exception of standard brakes almost as large as the wheels. One model uses a sturdy little four-cylinder engine and runs on special balloon tires. A number of the little fellows are said to have traveled sixty-five miles an hour! One, it is claimed, averaged forty miles to a gallon of gasoline.

Manufacturers use them to advertise their products; children of rich parents drive them as pleasure cars. A society woman ordered a special coupé model for shopping. She found it much easier to maneuver in traffic and to park in a limited space than a standard-sized automobile. The manufacturer, returning recently from a 1500-mile trip around Oregon, encountered muddy, rutted roads that discouraged many a large automobile, but his little machine with its narrow-gage wheels, ran undisturbed between the ruts.

The first of these mechanical marvels was an experiment for the builder. He bought a small used car, took it apart and cut it down, making new parts when necessary. When finished it was just half as large as the original. This little machine attracted attention on the streets and orders piled in for cars like it.

Jack Landon, small car manufacturer, starts for work after parking his midget machine like a bicycle, on his home veranda all night

What the World Wants of Inventors

NEW challenges to inventive genius are the latest entries in the "What's Wanted" book maintained by the Institute of Patentees in London, England, in which suggestions for needed inventions submitted by the public are filed.

An unbreakable shoe lace, a mechanical bricklayer, a folding umbrella that can be carried in the pocket—these are some of the devices laymen want. Particularly in demand are inventions that will make a dwelling more comfortable to live in, and ease the housewife's tasks. These are some of them:

Vacuum cleaners for chimneys.

A way to prevent the water in house pipes from freezing.

Apparatus to remove deadly carbon monoxide and unwanted carbon dioxide gas from living room air.

Another machine to fill the air with health-giving oxygen at low cost.

Windows of unbreakable, clear, flexible glass.

A means of cleaning windows by machinery.

Portable gas fires with their gas in a cylinder.

A better way of fastening carpets than by the use of tacks.

Non-slippery floor polish.

And in the kitchen the housewife would like to have:

Permanent paint for gas stoves.

A way to uncork bottles without destroying the corks by a corkscrew.

Motorists would appreciate a device to show when the tail-light is out; a mechanism to raise the car's hood that the driver can operate without leaving his seat; and a motor car that can swim across a river!

Nearly every profession is represented by the diverse requests for new inventions.

Photographers would appreciate a device to prevent taking two pictures on the same section of film by winding it automatically after exposure.

Musicians want an attachment for the music stand that will turn the pages of music for them.

Stamp collectors hope for a device that will permit the easy removal and replacement of stamps in an album.

Typists need an attachment for the typewriter that will sound a warning when the bottom of the page is about to be reached, this attachment to be adjustable to any length of page.

Army artillery men want a heavy gun that will automatically dig itself in.

Painters hope someone will invent a "fountain brush" that holds a pound or two of paint.

If none of these possibilities appeals to the would-be inventor, however, there are hundreds of other ideas awaiting him, all based on actual human needs.

Tips for Inventors

POPULAR SCIENCE MONTHLY maintains a list of "Inventions Wanted," made up of suggestions offered by its readers.

This list is open to the public, and may be inspected at the offices of POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

Chart Tells When to Marry

How You Can Predict Your Chances for Happiness by New Scientific Method

By HORNELL HART

A YOUNG friend of mine, a strapping lad of nineteen, was graduated from high school last June with the intention of entering an Eastern university this autumn. Employed in a seaside hotel during the summer, he met a charming girl of eighteen. They fell madly in love. Now they are to be married. Both are going to work to "support the family. It will be great fun," they say. And they are confident their marriage will be one of endless happiness. Will it?

A wealthy bachelor I know, a business executive approaching the half century mark, was introduced to a vivacious woman athlete exactly half his age at a dance not long ago. They became infatuated. He fully believes that at last he has met his ideal mate. So does she. Will their marriage be a blissful one?

Now, if any of the parties to either of these weddings should consult the oracle of scientific knowledge (which they are not likely to do) and ask: "Should we be married?" the answer would be something like this:

"It's a terribly dangerous gamble. The odds are all against you. The chances are your marriage will go on the rocks, ending in divorce and misery."

And that answer would be no guesswork prophecy of mere fortune telling. It would be based, not upon the stars, nor the flip of a card, but upon scientific conclusions reached through careful analysis of more than two thousand American marriages.

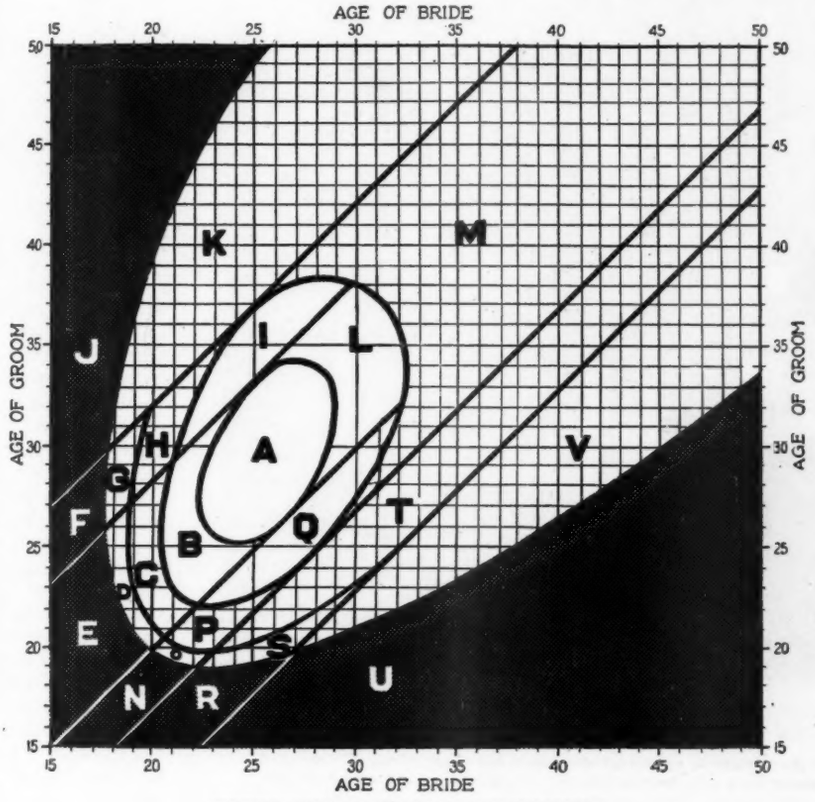
Those conclusions, reached after four authoritative investigations, show that marital happiness depends to a large extent on the ages at which couples marry; that from the age of the bride and bridegroom at marriage it is possible to forecast the future fortunes of the union with surprising accuracy. Age at marriage, of course, is only one of the factors affecting marital success. The physical, mental and emotional characteristics of the man and woman, not to mention financial and social conditions, play a part. But the investigations show age is a big factor.

The first inquiry was a study of 100 divorce cases in Cincinnati, Ohio, made by Miss M. E. McChristie and myself under direction of Judge Charles W. Hoffman. It revealed, for example, that a girl who marries before the age of twenty a man five or more years her senior is much more likely to seek a divorce than a woman who marries later and mates with a man nearer her own age.

The second was a study by Dr. Katharine Bement Davis, eminent sociologist, who obtained confidential statements from 1000 women, of whom 116 said their marriages were unhappy.

A third investigation was of child marriages, by Mary E. Richmond and Fred S. Hall. And the fourth was an analysis of a thousand marriages in Philadelphia by Wilmer Shields and myself. Of the thousand, 500 were cases in which couples had reached such difficulties that they had appealed to the Domestic Relations Court. The other 500 were taken from the records of marriage licenses.

From all these studies it has been possible to prepare a chart by which you can read the likely outcome of marriages at various ages.



YOUR CHANCES FOR HAPPINESS

This scientific marriage result forecaster was devised by Hornell Hart, Associate Professor of Social Economy, Bryn Mawr College. The letter in the area where the age lines of a bridegroom and bride intersect indicates their chances of happiness. Here is the key: A—Ideal. B—Not so ideal; if in doubt wait year or two. C—Risky; wait a few years. D—Very dangerous; both far too young. E—Exceedingly dangerous; wait. F—Divorce probable. G—A little less hazardous than F. H—Girl far too young; foolhardy unless otherwise excellently suited. I—Good chance if otherwise well mated. J—Suffering and divorce likely. K—May succeed if otherwise unusually well matched. L—Good prospect, although they waited too long. M—Fair chance. N—Hardly a chance. O—Both far too young; wait at least four years. P—Man too young; wait year or two. Q—Good chance. R—Very slim chance. S—Slim chance. T—May succeed if otherwise adapted. U—Age difference too great; almost hopeless. V—A little less hopeless than U. In every case, white area is safest; dark, most hazardous

ON THE numbered scales at the top and bottom of the chart make a check mark at the age of the prospective bride. Draw a vertical line connecting these two marks. Now, on the numbered scales at left and right of the chart make similar marks at the age of the prospective bridegroom. Connect these with a horizontal line. Note the letter of the area in which the two lines cross, then refer to the corresponding letter in the key list below. This will tell the future outlook for this particular couple. For example, if the bride is nineteen and the bridegroom twenty-two, the lines will cross in the D area. Look under D and you read: "Very dangerous; both far too young."

Observe that age combinations which fall in the all white area on the chart are most likely to bring happiness; the dark areas are most hazardous. In general, the investigations have revealed that the ideal age for marriage is about twenty-nine for the man and twenty-four for the woman. Marriages in which either party is nineteen or younger are from ten to a hundred times as risky as those at the ideal age. Marriages of persons over thirty-eight are from two to five times as hazardous.

Whirling Wheels

A Novel of Love, Speed Rivalry, and Mechanical Genius in the Making of the Age of Automobiles

He reached for her and she withdrew, as though she feared his touch. "Gail!" He tried to explain. She turned away from him, looking into the fireplace to avoid his haggard eyes

By

EDMUND M. LITTELL

Author of "Midge" and "Fire Shy"
Illustrated by B. J. Rosenmeyer

THE ambition of young Gil Herrick when he arrived in Wendenville, Michigan, back in 1895, was to establish a bicycle and repair shop; and, in spare hours, to work out ideas he had conceived for a motor wagon. Soon, however, he found himself involved in a feud with Jim Wenden, the town bully. One reason for trouble was that Gil roomed in the home of Mrs. Caswell and her daughter Abigail, whom Jim always had regarded with a sense of proprietorship. Another reason was a matter of speed rivalry. And it helped matters none that Gil found an unexpected champion in Jim's influential father, old Zach Wenden.

Bitterness grew when Gil, defeating Jim in a bicycle race, received a bunch of flowers from Abigail. And it became serious later when the two clashed in a motor wagon race, in which Gil drove a crude machine he had built in the Caswell barn; Jim, a foreign machine he had purchased. When Jim, the victor this time, was ignored by Abigail, he tried to steal a kiss, instead. Gil interfered. In a vain struggle against overwhelming strength, Gil's arm snapped and he fell unconscious. It was then that Abigail confessed her love for the young mechanic.

Mrs. Caswell, however, disliked Gil. By tears and threats she persuaded "Gail"—the name Gil had chosen—to leave her lover and accompany her to Boston. Before parting they planned to be married "just as soon as mother is settled."

But four years passed, during which Gil labored to perfect his motor wagon. Meanwhile Jim went to New York where he bought an interest in a company manufacturing electrically driven buggies. In Boston, Gail's affection for Gil was undermined gradually by Mrs. Caswell's subtle methods, by the infrequency of letters from Gil, and by frequent visits of the prospering Jim.

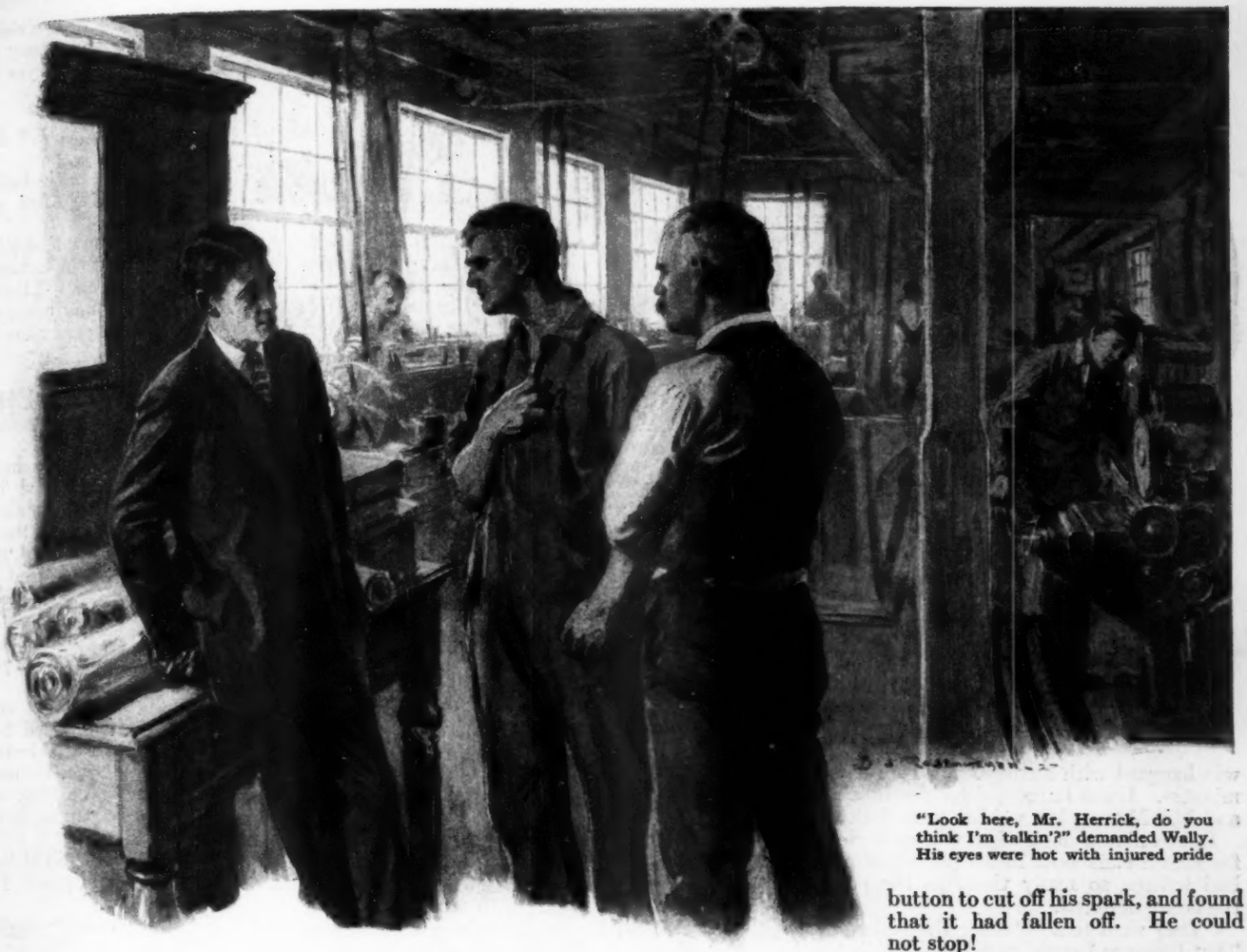
At last Gil, having developed "a real runabout", moved to Detroit where he established a modest automobile factory in an old carriage shop. And in November, 1900, he drove his runabout from Detroit to New York to exhibit at the automobile show. Recognition by the public, the sale of machines, a humming business—and Gail—these were his dreams as he arrived in triumph at Madison Square Garden.

But his high hopes fell to ruin. A deal with a New York business man for twenty runabouts was cancelled. Curious crowds that gathered about his machine failed to buy. Gail wrote that she and her mother were sailing for Europe in a few days. And, to cap the climax, Jim Wenden, whom he encountered at the show, intimated treachery in Gil's little factory. Someone, apparently, had given Jim the plans for Gil's new four-cylinder engine. "Oh that," Gil bluffed. "I scrapped that engine. Like to have the drawings? I'll send them to you."

Just when the future looked darkest, Gil met two young men, Andrews and Morton, who agreed to take fifty runabouts, and tipped him off to a friend named Tinsley, who planned to open an agency in Boston. Gil wired Gail: "Better unpack your bags," and set out for Boston. Success seemed again within his grasp. Now read on:

IT WAS nearly three hundred miles to Boston, and he planned to make it in a day and a half, two days at the most. The three men had spent most of Sunday night overhauling the runabout. "Good chance to see what makes the wheels go 'round," Andy Andrews had said. The runabout was in excellent shape, and with the new style tires that had been installed he should be able to establish a record almost as fast as that made by young W. K. Vanderbilt the July before.

Of course Vanderbilt hadn't driven so far; only from Newport to Boston. And he had used a thirty horsepower Daimler, with a French chauffeur who was licensed by his government to drive "all motor vehicles at all speeds." He had covered seventy-two miles in two hours and eighteen minutes, an average of better than thirty-one miles an hour, with a speed as high as sixty-five in some places. What had slowed him up was tires. He had been compelled to stop suddenly many times—his machine had five sets of brakes—and every time he did so a tire



"Look here, Mr. Herrick, do you think I'm talkin'?" demanded Wally. His eyes were hot with injured pride

had flown off. But he had gone prepared for such emergencies, and the fact that he had ruined three fronts and five rears had delayed him only long enough to replace one each time from the pile he carried with him. Gil's car was much lighter; he should have no such trouble. Slower speed and steadier pace; that would do it.

THE Boston Post Road, New Rochelle, Port Chester, Greenwich—the villages were checked off with a steadiness most encouraging. Rough roads, but velvet compared to what he had so recently covered. The people along the way seemed to be more accustomed to horseless locomotion, too. The horses—at first—were almost indifferent. Why not, when during the past summer many imported machines had been circulating on these roads? Mercedes, Renault, Benz—they were all represented. Wealthy New York had taken up the fad; the logical sequence was that the great public would follow suit—with his low priced runabout.

On, through Stamford, Bridgeport, New Haven. Crowds of the curious gathering at every stop, slowed him down considerably in the populated centers, but he arrived in Narragansett Pier in good time, to "stable" his machine in the shed of an old Post Road tavern. He hired a guard to watch it all night, so curious were the natives, ate a late supper and went to bed, after turning up his oil cups, and slept like a child. One hundred and twenty miles to Boston!

In spite of his early start the next day, it was after four when Gil stopped in Boston Common. He had had engine trouble. First his dry cells ran down, but that was easily remedied; he had an extra set. Then the jouncing over the roads shook a number of bolts loose; he had to crawl under and tighten up an engine that was thumping dangerously. Once, on a level bit of straightaway, he was going almost thirty miles an hour when a farmer appeared on the road ahead of him. He succeeded in slowing down by retarding his spark, but, when the horses began to shy and he tried to throw out his clutch to stop, he found that it was stuck. Then he reached for the button to cut off his spark, and found that it had fallen off. He could not stop!

Nothing to do but whiz on past the irate farmer, fortunately with no damage save to his dignity, and wonder how to halt his uncontrollable machine. He waited for a favorable stretch of unoccupied road, reduced his speed as much as he could, then yanked his gear shift lever into low. It was risky, for it threatened the destruction of his transmission, but he got into low without apparent harm. Then he dropped from his seat and ran around in front of the slowly moving buggy, where he reached underneath the dash—his fingers knew exactly where to go—and yanked the ignition wire free. The machine stopped, and Gil made note of another necessary improvement—a switch that would not drop off.

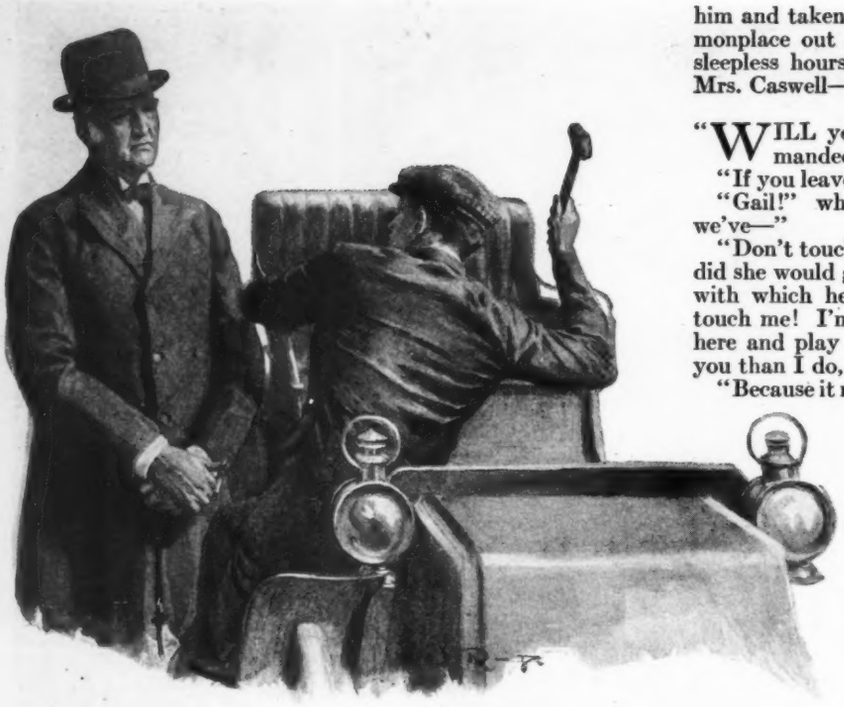
It was almost an hour before he had remedied the sticking clutch and re-attached the wires. Thank goodness, the transmission had stood up! After that, barring one blow-out which came as he was nearing Boston, the trip was uneventful. He had two spare tires fastened on the deck behind him and it was only a matter of some forty-five minutes to change. Next time, now that he knew the trick of six clamps, he ought to be able to do it in thirty; maybe less.

BOSTON, and a reception committee waiting. More of Andy Andrews' work. Ten automobiles, with a Mr. Glidden in charge. "Sorry there aren't more of us, Mr. Herrick, but the others couldn't get away. There's quite a number of enthusiastic sportsmen in Boston; they are increasing every day, and you ought to find a splendid market here. Now—the streets are a trifle crooked, you know, so if you will follow me until we get a little further in—"

Tinsley had an office on Boylston Street, and after the demonstration on Boston Common, Gil hurried there with him for a word. "If you don't mind postponing our talk until tomorrow," said Gil, "I have a very pressing engagement. Friends, sailing tomorrow—"

Mr. Tinsley, heavy-set and tending toward baldness, was sorry.

"My wife is very ill," he explained. "I left her only an hour ago, and I won't be able to leave her again." His rugged face



"Wager? On that thing? Last thing in the world to bet on!" The banker was still gruff, but with the vaguest indication of interest. Gil's hammer continued to rap furiously

was haggard with anxiety. "If you can arrange to talk a few minutes. I was impressed by the reliability of your machine, and Mr. Morton has written very enthusiastically—"

It was nine o'clock when Gil, dinnerless but with a contract for fifteen runabouts in his pocket, stopped at the address he had written so many times in the past four years—to find the house deserted.

"They went to a hotel for the night," a neighbor explained, "but I'm sure I couldn't tell you which one."

It was midnight before he found them, and Mrs. Caswell, bright of eye and smiling with unusual cordiality, came downstairs.

"MR. HERRICK, I'm so sorry," she said. "Abigail has been in bed for two hours. So tired, you know, after all the excitement of packing."

"She—can't see me?"

"She doesn't even know you're here; she's sound asleep. And you wouldn't waken her, would you? It is too bad, when she has been expecting you for so long. She even broke an engagement with James Wenden tonight."

"I don't—understand."

"Do come and have breakfast with us in the morning, Mr. Herrick. It will seem quite like old times," said Mrs. Caswell hospitably. "We'll have time for a short visit before we board the ship."

"But—isn't she going to stay?"

"I'm sure she can explain that in the morning. Good night, Mr. Herrick. So sorry you were late."

She even shook hands with him again before she turned and swept across the small lobby to the stairs—and a daughter who was anything but asleep.

"I won't see him," Gail had sobbed. "After all these years he takes two days to come to me—"

Which accounted for the warmth in Mrs. Caswell's greeting and the conquering air with which she turned her spare back upon a former boarder. He saw it—and wondered.

"Got a room here?" he asked of the clerk. "And a shed or something for that buggy of mine?" His voice was harsh.

"NO, Gil, I'm going to sail with mother." That was what Gail said when they had breakfasted together and a haggard-faced, hollow-eyed Gil had followed them to their room. Gail was lovely, more beautiful than his fondest dreams had pictured. That hair with gold in it, those fingers that had toyed with their food, those blue eyes, so bright and evasive above lips that had chattered nothings about the trip! Gil was hungry, but not for the food that had been set before him and taken away untouched; he could scarcely drag a commonplace out of his dry throat. Upstairs, after an agony of sleepless hours and a breakfast of nothing under the eyes of Mrs. Caswell—to that!

"WILL you leave us alone for a few minutes?" Gil demanded of Mrs. Caswell.

"If you leave the door open," said she. "I'll wait in the hall."

"Gail!" when she had gone. "You can't! After all we've—"

"Don't touch me!" Her voice was sharp; she knew that if he did she would give in. Why didn't he? Where was the defiance with which he had once tackled big Jim Wenden? "Don't touch me! I'm sailing with mother, I tell you. You can stay here and play with your old motor wagon. It means more to you than I do, anyhow."

"Because it meant—you! So we could—"

"Be married when *you* got ready! Me, sitting here four years, and all last evening, and you—Ha-ha!"

He reached for her and she withdrew, shrinkingly, as though she feared his touch. "Gail!" He tried to explain—about the show, and the heartbreak there, the unexpected joy that had followed, the reason for driving to Boston instead of rushing by rail, and its result. "Fifteen runabouts, look there!" He showed the contract, but she turned her eyes away. "Why? Because—oh, Gail, don't you know why?"

It should have melted her, that cry; would have, if only he had seized her, even touched her. But he was afraid—Gil, the defier of big Jim Wenden. He stood inactive, stunned, because she had put a chair between them, a blistery, upholstered thing that was easy to push aside. She turned away, looking into the fireplace to avoid his haggard eyes.

"I don't see why we should talk any more," she said at last. Her voice was tired. "It won't do the least bit of good. I'm sailing with mother."

In the mirror above the mantel was a picture of his sagging shoulders, hands—those hands that had built something out of nothing and swung on Jim—hanging slackly, palms outward; eyes that yearned toward her. She looked down again at the fire.

"I—I was going to take you for a ride—"

Silence. Until she heard another voice, her mother's: "Aren't you going to wish me bon voyage?" Brightly, from the hall outside. She turned about. Gil was gone, had retreated across the carpeted floor without a sound. Now he was mumbling something to her mother. She ran across to the door. "Gil!" He was gone, down the stairs. Her mother's arm embraced her comfortingly, and arrestingly. Clever Mrs. Caswell! The impulse to pursue was forestalled by arms that soothed.

"There, dear; it's all right. Finish your packing now; you'll forget all about him in a week."

"But I don't want to forget him!" The tears that had been restrained behind too-brilliant eyes began to overflow, while Gil, downstairs, was greeted by Jim's heavy, jaunty voice:

"And here's the wanderin' boy! Well, well! Leavin' us so soon? Always in a hurry, ain't you, Gil—bert?"

* * *

MR. Oliver H. Marston was annoyed. He stood behind the broad plate glass of his library window with his bushy, snow-white brows lowered ominously. He had been there for much more than an hour.

"Has that thing been out in front ever since this morning?" he was saying over his portly shoulder to his wife.

"It has, my dear, with that man working at it all the time."

"Outrage, that's what it is. Personal affront. Menace to the public. Nuisance. And nothing to be done about it."

He knew that, the Oliver H. Marston who glowered so belligerently; he had tried doing something. All his influence had been brought to bear upon the city officials, and he had no little power, but they only shrugged their shoulders. "They're obeying the laws," said they. "We're seeing to that. And as long as they do—"

And that thing had been out there all day! In the morning, when he had driven his team of high- *(Continued on page 168)*

Next—the Crash-Proof Plane

Inventor of the two-piece airplane, Joaquin S. Abreau, shows with a model how the engine section is released

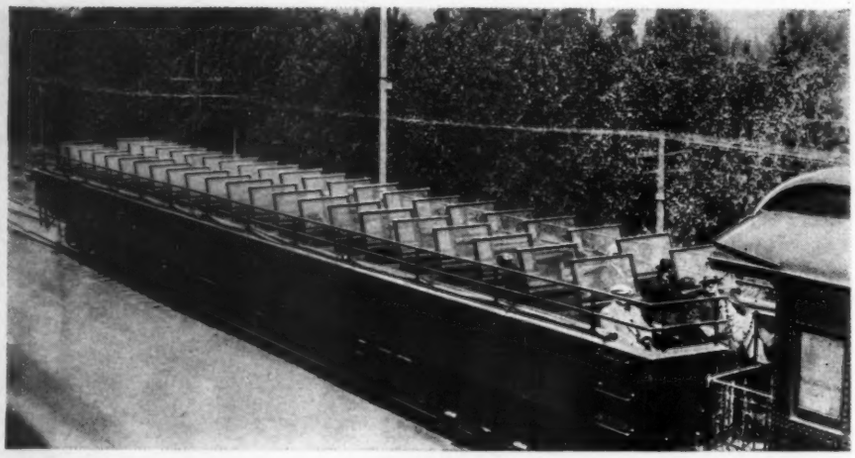
FLAMES leap from the hood of the speeding plane. It sways, quivers. Instantly the pilot pulls a lever marked "Emergency." Down like a plummet drops away the whole undersection of the plane, the burning engine with it—and pilot and passengers swoop to a safe landing in a motorless glider.

This amazing two-piece airplane, whose wings support a detachable passenger cabin, is the invention of Joaquin S. Abreau, of San Francisco. With the model he is holding in the photograph at the left, he illustrates how by a trigger the under part which carries the engine is released.

Various such schemes have recently been proposed and in the sketch above the artist pictures several in operation. That in the foreground, Abreau's invention, has received favorable comment from postal authorities as a possibility for air mail service.

Another, shown in action at the lower right, is a detachable cabin large enough for passengers and crew. A self-opening parachute swings the cabin free. Dr. Roland Eisenlohr, a German inventor, proposes this device.

A forerunner of these schemes was the airplane-parachute designed by Harry Doucett. As previously described in POPULAR SCIENCE MONTHLY, this device is a huge parachute capable of letting an entire disabled plane gently down to earth. The farthest plane in the sketch above has this device.



A Sight-Seeing Railroad Car

SIGHT-SEEING accommodations in the Pacific Northwest approach the de luxe with the advent of this open observation car, equipped with individual windshields, as shown above.

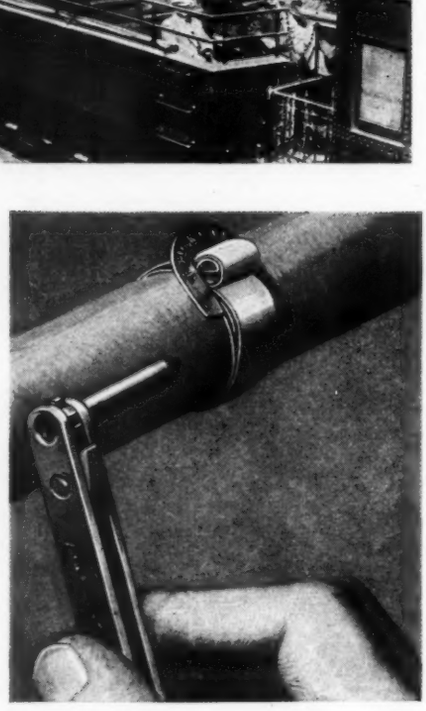
The Union Pacific Railroad recently put into operation on its Columbia River Gorge division in Oregon these luxurious cars, open at the top to permit observation of the towering mountains en route. Additional comfort for the passengers is obtained by use of forty-four individual windshields, to be adapted to each passenger in the car. The fine weather of the Pacific Coast country makes open cars practicable; oil burning and electric locomotives have eliminated dirt and cinders; now apparently the last possible objection to railway touring has been met with the windshield cars.

Coat of Paint Warms House

YOU can keep your house cooler in summer and warmer in winter merely by choosing the right kind of paint for covering the roof. That startling conclusion follows recent tests made by the American Society of Heating and Ventilating Engineers at the U. S. Bureau of Mines, Pittsburgh, Pa. With electric instruments that measured heat flowing through a sunlit roof, the engineers found that a white roof for a house is as cooling as the white clothes you wear in summer; and shiny aluminum paint is even better. It reflects away the sun's hot rays, and a roof coated with it transmits thirty-eight percent less heat inward. Moreover, this seems to work both ways; in winter, some heat escaping from the house is probably reflected back again, resulting in a fuel saving.

A Mystery of the Heavens

"THE most serious riddle I have met in the examination of thousands of plates," says Dr. Ejnar Hertzsprung, Dutch astronomer, of a phenomenon reported by the Harvard Observatory. On two photographs taken through a Harvard telescope appeared a mysterious object, like the image of a bright star. Then it disappeared. The phenomenon may have been caused by a collision of two dark bodies, like meteors, producing a momentary flash of light, Doctor Hertzsprung suggests.



Steel Belt Mends Tools

HOME repairs to innumerable breaks in tools and household apparatus are possible by a newly invented self-locking steel tape, by which the breaks are clamped and held under pressure, as by a belt.

The ingenious repair kit applies a metal strip as easily as if it were adhesive tape. A special tool is used, and the finished mend is a neat, tight-drawn band of metal held in place by a diminutive "buckle," as in the above photograph.

Snakes' Hospital Has Beds And Diet of Imported Bugs

A "SNAKE hospital" with comfortable beds in it and a resident physician to care for the reptiles' ills, is an amazing feature of the new reptile house of London's Zoological Gardens. It boasts a diet kitchen, a battery of artificial sunlight lamps, and other equipment of a hospital for human beings.

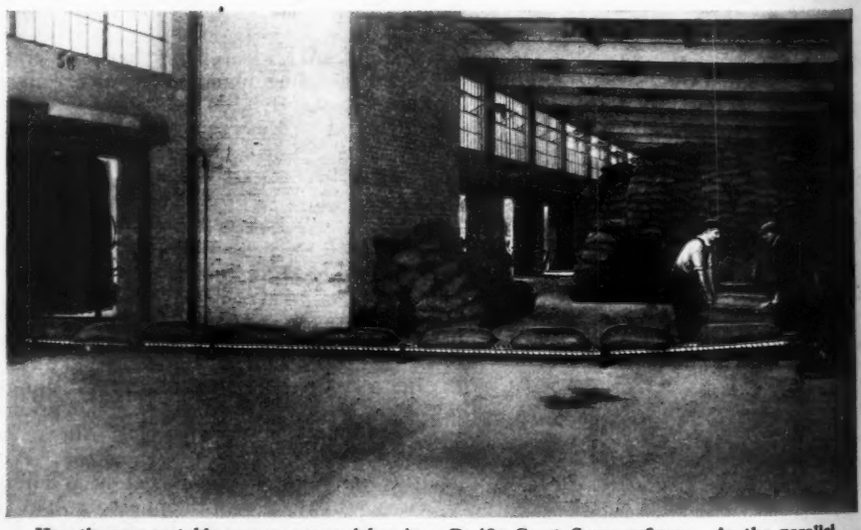
Snakes brought to this zoo from all over the world thrive under the care lavished upon them. Electric thermometers flash red or green lights whenever the temperature is too hot or too cold for the delicate constitutions of the reptile guests. In an adjoining "insectarium," rare and foreign bugs are raised to luscious fatness for snakes that can thrive on them alone, with all the care a hotel chef might expend on meals for guests.

The reptile cages themselves have no resemblance to the usual barred and screened inclosures. Wide and spacious, they are "landscape-gardened" to make the inmates feel at home in surroundings like those of their native countries.

Whirling Shafts Move Sugar

WHIRLING screws whisk sacks of sugar through a warehouse in the remarkable new portable conveyor, driven by electricity, shown below. Light in weight, it can be moved about the factory and set up anywhere in a few moments without need of any rigid and elaborate framework to hold it.

Two jointed horizontal steel shafts, threaded in opposite directions, rotate toward each other and, like huge screws, propel the sacks forward on the runway between them. Their inward rotation keeps the sacks from falling off. Flexible joints make it possible to lead the conveyor across and over irregular piles of material, to save hand labor on piling sacks at any point. A Pacific Coast sugar refinery developed this handy invention of two employees. While now used only for sugar, the device can be utilized for carrying grain and other material in sacks in quantities. Sections may be added to and taken from the shafts to suit required distance, carrying bags upstairs and even around corners if desired.



How the new portable conveyor saves labor in a Pacific Coast Sugar refinery. As the parallel shafts rotate toward each other, their threads gently but swiftly move the bags of sugar forward

Silk Made from Cornstalks Promises Farmer Profits

SILKY cloth, strong enough to be fashioned into clothing, is the latest product which the chemist's magic is extracting for the farmer from those hitherto wasted by-products—cornstalks.

Samples of the fabric were exhibited recently by Dr. O. R. Sweeney, chief chemist of Iowa State College, with paper and lumber substitutes also made from cornstalks. In the May POPULAR SCIENCE MONTHLY, Dr. Sweeney described adhesive, charcoal, solvents, embalming fluids and chemical as other commodities which cornstalks might produce. He now estimates that a 160-acre field would yield enough stalks to net the farmer a profit of $5,000, provided the farmer controlled the manufacturing.

Dr. Sweeney told a meeting of bankers that experts had informed him the country undoubtedly would some day use a billion pounds a year of artificial silk made from cornstalks—serviceable for all purposes for which silk is now used.

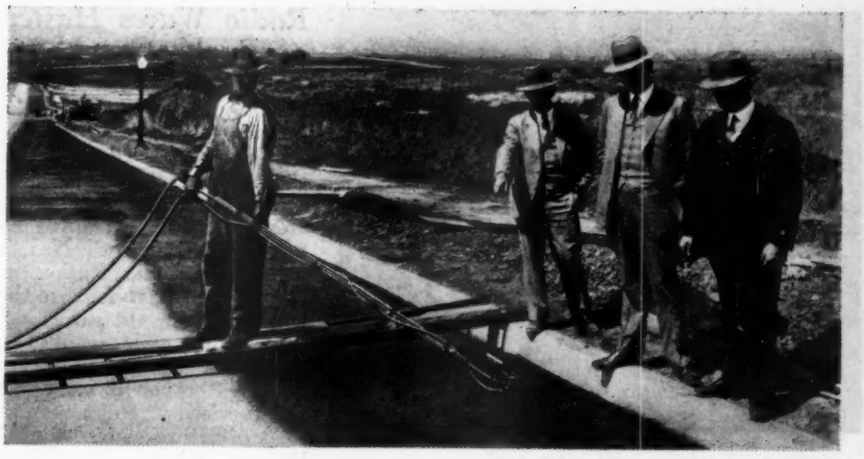
"Centipede" Aids Tunneling

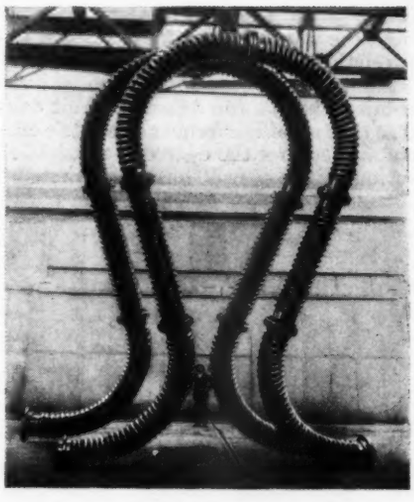
THE huge mechanical centipede shown below, and two others like it, will save the engineers of the Moffat Tunnel in Colorado $2,500,000. It is called a "cantilever girder," by its inventor, George Lewis, general manager of the project; it crawls on its back into the tunnel as it is excavated, and with protruding arms supports the roof, eliminating cave-ins.

Manpower formerly did the timbering, and often it was necessary to repeat the process several times. Now these machines, which resemble centipedes, do the work faster and better. They have the strength of hundreds of men. Drilling and blasting of the bench on which they rest do not disturb them.

The girders measure sixty-five feet long, ten feet high and eighteen feet wide. They weigh fifty tons each.

The Moffat Tunnel will now be completed nearly a year earlier than expected. It will shorten the rail distance between Denver and Salt Lake City by twenty-three miles and will materially reduce the gradient of the railroad.

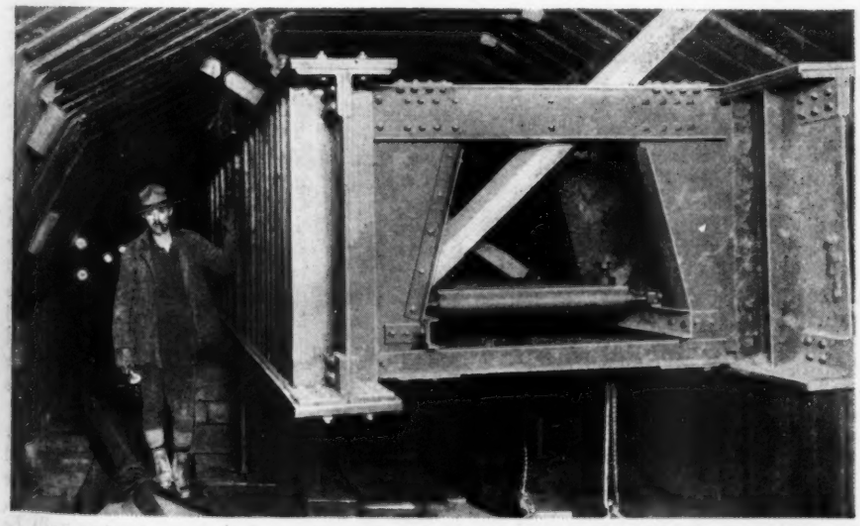




Giving Steam "Elbow Room"

EXCESSIVE expansion of steam pipes resulting from high temperatures has been accommodated in a unique manner by these large ducts, recently constructed in France, composed of flexible corrugated pipes. The flexibility permits the loops to adapt themselves to whatever expansion the steam causes. The loops illustrated, which are many times a man's height, can absorb an expansion of more than twenty inches.

The corrugations, causing flexibility, are put in the pipes by a shaping machine.



As the Moffat Tunnel in Colorado is bored and blasted, this structural steel girder is pushed in on a track, supporting the top and preventing cave-ins. Three such girders have greatly speeded the work

Asphalt "Cures" Concrete

CONCRETE that is 15 percent to 30 percent stronger than the usual kind is now made possible, it is claimed, by a curing process, perfected by a Los Angeles corporation. "Curing" is the treatment of wet concrete by which its moisture is conserved in order that the concrete shall dry slowly and uniformly. This slow drying gives it greater strength. It is usually effected by covering the fresh poured concrete with water or wet dirt for two weeks or longer—a troublesome and somewhat expensive job.

The new method, known as the Hunt process, entails spraying the fresh concrete with a secret waterproof solution of asphalt, which seals all surface pores and holds the internal water for a considerable time. The illustration shows the solution being applied by a spray gun. Not only is the new concrete stronger, it is said, but it dries with a nonglare and nonskid surface.

New Tones from the Flute

NOT content with possessing the only gold flute in the world, Prof. Dayton C. Miller, of Cleveland, proposes to construct one entirely of the more precious metal, platinum. Such a flute would probably be intrinsically the most expensive musical instrument in the world.

It is its probable tonal quality, however, that makes the platinum flute so desirable in Professor Miller's eyes. He has invented a unique device, the "phonodeik," by which he produces waving lines of light on a screen, showing the tones produced by musical instruments of different densities. His gold flute, for example, produced an entirely new set of tones. And platinum, being still denser than gold, he believes, would give still another tone quality.

Platinum Analyzes Breath

BY A new process the gases that you exhale in breathing may be analyzed in from six to ten minutes, instead of the thirty or forty formerly required. Chemists of the U. S. Bureau of Standards perfected the method. What the gases consist of is shown by the amount of heat lost from a delicate electrically heated platinum wire surrounded by a sample of the gas. Studies of hygiene and food-energy investigations are thus greatly facilitated.

"Pillows" Made of Milk

MILK, in these days of diverse by-products, means a good deal more than a wholesome beverage. It may be the "jewel" in your ring, the leather in your suit case, or the linoleum you walk on.

There is far greater demand for butter and cream than for skimmed milk; consequently, the residue from the creameries has to be utilized in other ways. The illustration shows the "pillows" of curd, obtained from the milk by chemical treatment, drying, and pressing. Later, they will be ground into powder.

This curd, or casein, which forms about one-tenth of the body of the whole milk, is an important part of many paints, varnishes, cements, and enamels. It goes into various cardboards. It gives weight to many textiles. Even artificial stones for jewelry are made by the magic of industry from this same skimmed milk!

Gas Warfare Called Humane

THE prevailing opinion that gas warfare is "devilish, brutal, and should be abolished" is unfounded, according to the recent statements of two experts on the subject. In fact, they declared, gas can be one of the least brutal yet one of the most effective weapons of combat.

Before the Institute of Chemistry of the American Chemical Society, Dr. J. E. Mills, Chief of the Chemical Warfare Division, U. S. Army, asserted that the airplane, gas, and the submarine were the most powerful weapons of modern warfare. Gas, he added, has the advantage over older forms of warfare in that it can be made humane whenever it is possible to exercise humanity. And he urged the development of the science of gas manufacture, along with the development of aviation, as a "blessing to the world, not a curse."

Dr. Harry N. Holmes, Professor of Chemistry in Oberlin College, even suggested a public test of the methods of gas warfare on a city of 10,000 people as the "quickest method of convincing public opinion of its value and humanity.

"It would be well worth while," he said, "to drop tear gas, as one that is obnoxious but not dangerous, on a civilian population which has been given about as much warning as they would get in warfare. Every citizen should first be provided with a gas mask. It would be most interesting to see how quickly a population of 10,000, for example, could protect itself from the tear gas."

Radio Waves Hasten Barley Growth

RADIO waves make plants grow, is the recent amazing statement of Admiral W. H. G. Bullard, Chairman of the Federal Radio Commission. Under his direction, a crop of barley was planted beneath the towers of the Navy's high-power radio station at Arlington, Va., to fertilize the soil for subsequent gardening. The barley grew rapidly so high that a full-sized man walking through it would be lost to view. "This apparent freak of nature," says Admiral Bullard, "was undoubtedly caused by the electric energy released from the waves due to the vibrations between the lofty antennae and the ground."

A similar effect has for some years been obtained by a large American fruit concern that uses high-frequency electric currents to control the degree of ripeness of various kinds of fruit for the market.

Electric Timer at Regatta

NOW it is possible to time water sports just as accurately as automobile or other land races.

The illustration above shows a new electric timer for rowing races, first used at a recent intercollegiate regatta in the East. The experiment was successful, and in the future all such events may be timed by similar devices. The principle is the same as that applied to speedway racing.

Poor Blood Causes Old Age

IMPURITIES seeping into the blood fluid from bad or excess food in the digestive tract are the real cause of "old age," according to Dr. Leonard Williams, British physician. They adulterate the "plasma" — the watery yellowish fluid in which the blood's red and white corpuscles float—and hinder its waste-removing duties, he says.

Light eating, short fasts, and attention to food quality will help postpone old age, Dr. Williams asserts.

Study Your Rainbows; Data May Aid Science

NEXT time you see a rainbow in the sky, make careful note of its colors, their arrangement and brilliancy. Then save your notes for comparison with subsequent rainbows.

You may think all rainbows are alike. Actually, though, each one is different, according to a recent statement of British meteorologists. In fact, from their differences may be learned valuable new facts about weather conditions.

"The colors of a rainbow, as well as their extent and the position of greatest luminosity, depend on the size of the raindrops producing them," say the British authorities. They suggest that observers who will record the sequence of colors, the color which is brightest, and the color with the widest band, actually will be able to calculate the size of the drops. Mariners at sea and amateurs on land are urged to make these observations.

Everglades to be Drained

BEFORE long the Everglades—Florida's famous tropical marsh—may be no more. Final plans for its drainage have been completed by the State, and the Legislature has authorized bonds to finance the gigantic reclamation project.

Ninety miles long and fifty wide, the historic swamp, infested with tropical reptile and insect life, has long been the subject of various reclamation schemes. Early attempts won small strips of the land for civilization; but canals must be cut clear through it to the sea before the vast marsh can be rendered habitable.

Hands Shape Hammer Shaft

APPROXIMATELY 360,000,000 blows, during thirty years of continuous use, moulded a hammer handle to the form of hands that used it.

This tool is owned by a Philadelphia sawmaker to whom it was handed down by his father and his grandfather, also sawmakers. The hammer was used daily to set the saw teeth. This process calls for hammering alternate teeth slightly outward in opposite directions. The average saw contains 180 teeth, and an expert sawsetter can handle 300 saws daily, which means 54,000 blows every working day, or 12,000,000 a year! And during the thirty years' use, the hard wood handle of the tool gradually assumed the shape of the workmen's hands.

The handle is of hickory and, despite its age, could be used by several more generations of sawmakers, but the hammer will be kept as a curiosity.

Twelve million blows a year for thirty years were struck with this hammer by three generations of sawmakers. See how the handle is worn

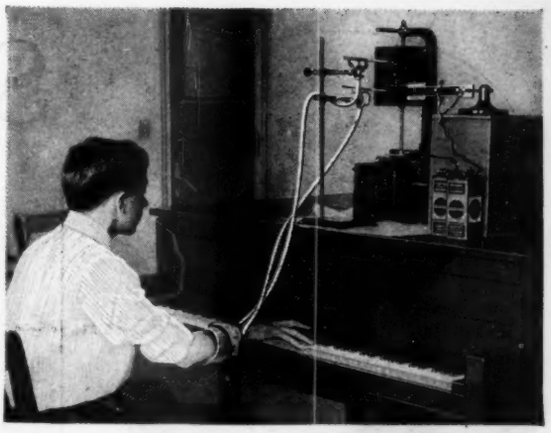
English Foot Census To Standardize Sizes

GREAT BRITAIN has started something which, in the end, may save the world billions of corns and foot-aches. The Government, through its Department of Scientific and Industrial Research, recently has undertaken a census of the nation's feet. The purpose is to take measurements of various shapes and sizes in different localities, with the idea of making shoes to fit.

So far, the making of shoes has been largely hit or miss. There has been little knowledge of actual variations in foot size and shape among people of different races, ages, and occupations to serve as an accurate basis for measurements.

Some experts believe results of the British survey will show that human feet can be classified into relatively few types. These then can serve as standards for making comfortable shoes for almost any feet, no matter what the shape.

"Speedometer" Used To Measure Crops

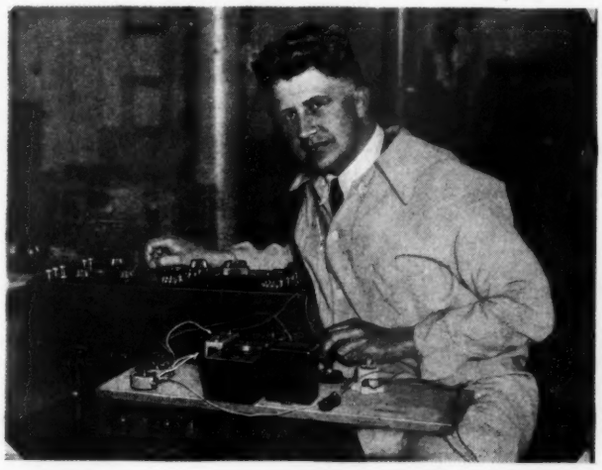


CORN and cotton fields were successfully measured last summer by the U. S. Department of Agriculture's remarkable speedometer-like "crop meter," a device attached to an automobile. As described in a previous issue of POPULAR SCIENCE MONTHLY, this apparatus was designed to count crops instead of miles on its several dials, showing the proportionate distance along any given route through the farming district occupied by wheat, oats, corn, or other crops.

Valuable records were obtained on several automobile "explorations" that showed the percentage of land devoted to the cultivation of each of these products. Next year the same route will be covered, and for the first time it will be possible to state accurately whether the growers are devoting more land to wheat, say, and less to corn than in the preceding year.

Filming Quakes

Plans for motion pictures of earthquakes have just been announced by the U. S. Coast and Geodetic Survey. One of its experts, Capt. Paul Whitney, recently conferred with seismologists of the University of California to locate the "faults" or rock breaks along which earthquakes occur. Cameras will be set on these lines, so arranged that a quake will start them taking movies of the shaking ground. The Survey hopes to anchor the cameras to remain fixed while the earth trembles.



Helps Ships Defy Fog

SHIP collisions in fog may now be averted with a new radio "whistle detector" designed by Frank Rieber, a consulting engineer of San Francisco. The delicate apparatus is said to pick up the inaudible sound of a distant ship's whistle, show the direction from which it comes, and tell how far away it is. With this warning, given long before the approaching vessel's siren is heard by human ears, the pilot can alter his course in time to prevent a crash.

Once every second, a three-foot dishpan-shaped megaphone revolves, sweeping the horizon for the sound of a whistle or bell. Within this sound-collector is a sensitive microphone, connected to radio apparatus. When a whistle is detected, says the inventor, its sound is caught and amplified many times and the radio apparatus lights a lamp on an indicator that shows the distant ship's position, revealed by the direction of the megaphone. The strength of the signal shows the vessel's approximate distance.

The photo shows the inventor with the radio apparatus that is a part of his "whistle detector."

Smallest Book in the World

THE smallest book in the world could get lost under a nickel.

This midget volume, 166–1000 of an inch across and 6–100 of an inch thick, contains 64 pages! The printing was done by specially processed plates, 112–1000 of an inch wide. The tiny volume is an illustrated Rubaiyat of Omar Khayyam, with an engraving of Edward Fitzgerald, the translator.

The book is the property of Russell M. Arundel, Washington, D. C. collector.

Tests a Pianist's Muscles

PIANO playing can now be criticized from an accurate record, instead of entirely from the aural memory. A device perfected by Otto Artman, a Baltimore piano instructor, writes a record of the performer's arm movements during playing. By comparison with an expert's record, errors are discerned.

A bellows is attached to the arms, and a delicate needle inscribes the muscular behavior on a revolving cylinder.

Vampires Let Victims Sleep

CAN vampires, the fearsome blood-sucking bats of the tropics slit a man's flesh so stealthily in the night that he may lose his life-blood in his sleep? Yes, says C. H. Townsend of the U. S. Department of Agriculture, in a recent statement in the New York Zoölogical Society Bulletin, contradicting another naturalist's opinion that such a bite would cause instant awakening and that the wound would not continue to bleed, due to possible astringent qualities of the bat's saliva.

Several cases are on record, says Townsend, of the vampire's deadly work. In La Chorrera, Panama, a young girl was bitten on a toe, as she slept, by a blood-sucking bat. Relatives found her still asleep, bathed in blood. She recovered but suffered from anemia. Later in life she had an anemic maid who also showed two circular scars, where a vampire had bitten away the flesh. The bites are usually where the blood will flow freely, as on the toes. Chisel-like teeth inflict the wound, neatly scooping out a piece of skin to draw the blood; and the bat's stomach is modified to suit its liquid diet.

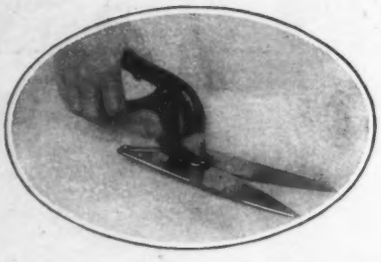
Only two families of bats, the *Desmodus* and the *Diphylla*, are blood-suckers, says Townsend.

Hardy Germs Survive Boiling

THOUGH boiling kills most disease germs, a few can resist prolonged heat, according to recent researches by bacteriologists of the Hooper Foundation for Medical Research at the University of California. Tetanus, or lockjaw, germs, the tests showed, can survive ninety minutes in boiling water. Botulinus, a meat-spoiling bacterium, can live after five and a half hours of boiling.

Many disease germs may live for years in freezing temperatures.

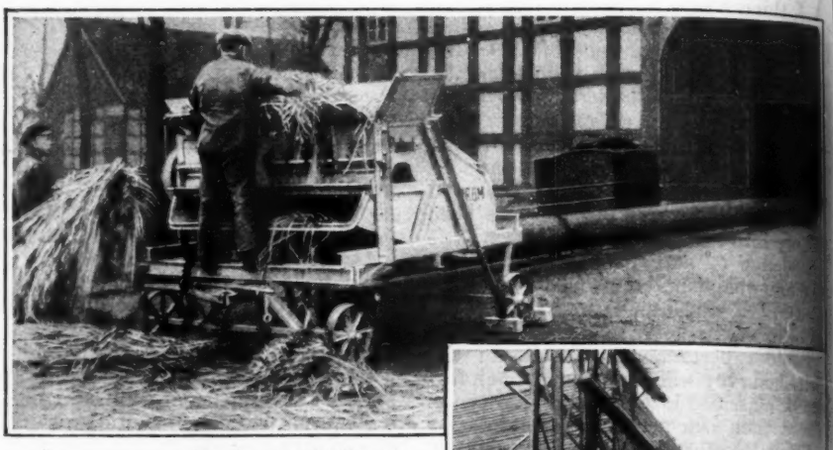
Sixteen Needs



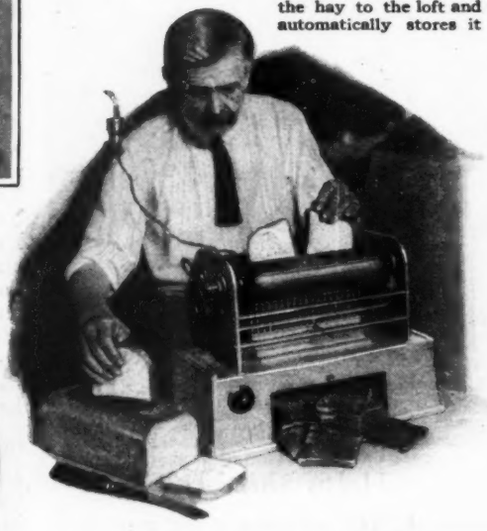
With these shears you can clip grass without tiring the hands. A jointed bar connects the blades, which open and close as the up and down motion of the grips bends or straightens the joint

A cent in the slot, and in two minutes the "hair-curling automat," invented in Europe, electrically heats the attached iron. The hotel guest, aided by the mirror, does the rest

To remove a broken-headed screw, drill a hole in it, drive in the fluted end of this tool and twist the square end two or three times with a wrench



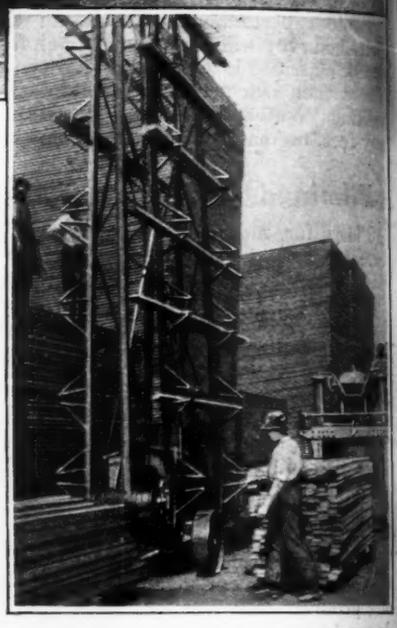
Hay is cut and delivered into a tube by this German machine. Air driven through the tube carries the hay to the loft and automatically stores it



Sixty slices a minute is the capacity of the toaster shown above. Bread passed between electrically heated graphite rollers comes out below, toasted, in two seconds. Thick cuts take longer. The dial on the front is used to regulate the roller speed

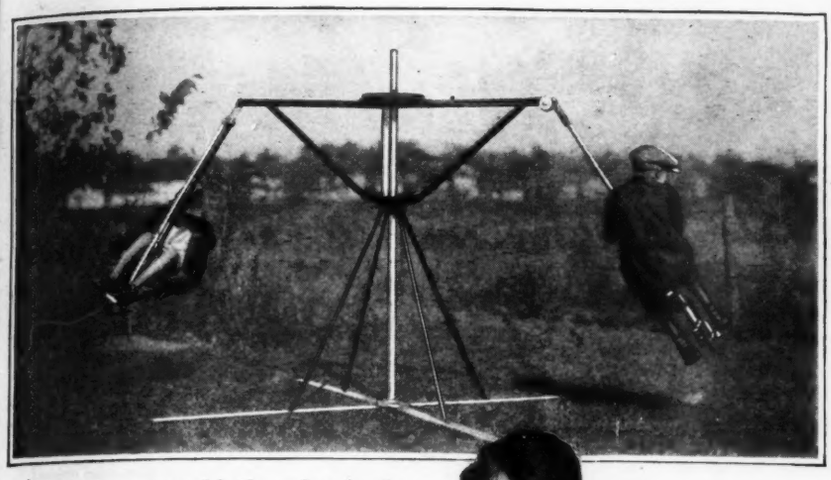
Imperfections in a singer's notes that are so slight as to escape the ear are seen with the eye by the device at right. Each circle of dots on the rotating disk represents the vibrations of a true note. The flame responds to the vibrations of the singer's note. If these correspond to the dots, the latter appear like a continuous line, not moving points

A swimmer's life preserver that weighs two ounces and can buoy a 250-pound man is demonstrated at the left. Toy balloons with a tiny bomb of compressed gas are inclosed in a folded cloth ball. Squeeze the preserver and steel prongs burst the bomb, inflating the balloons. The picture shows one of the balloons collapsed on the shoulder, the other inflated. In the right hand is the inflating mechanism

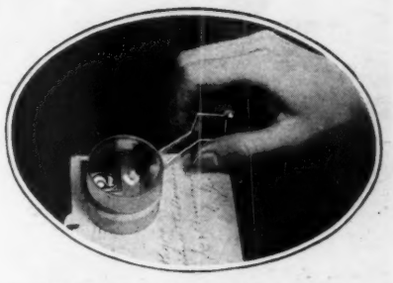


Brackets on perpendicular belts, moved by an engine, elevate lumber for piling in a huge mill yard. When the belts turn at the top the opposite brackets lower the boards to the desired height

Met *by* Ingenuity



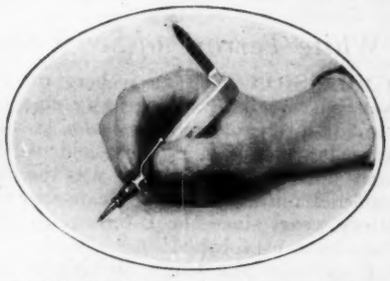
Their own merry-go-round is the cycle swing for children shown here. The seats are saddles, swung on swivels from the crossarm. Pedals under one seat operate a sprocket and an endless chain, which extends to the top and conveys power to a center wheel that turns the device for all who are riding



A magnifying glass that needs no focusing is flat on the under side, convex on the upper. Simply lay it, as shown above, on what you wish to examine. The metal holder can be removed easily if desired

The problem of drinking on swaying trains or boats without endangering clothing is solved by the non-spill glass pictured above. Its small top outlet makes it suitable also for use by those ill in bed

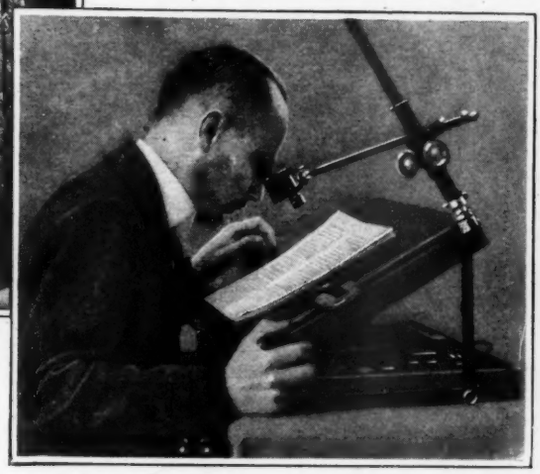
The thornless rose and seedless orange are joined now by the skinless "hot dog." The frankfurters at the right were inclosed in a synthetic vegetable covering instead of the usual membraneous skin. The vegetable jacket is removed after the "dogs" take shape and before they are shipped to market from the factory



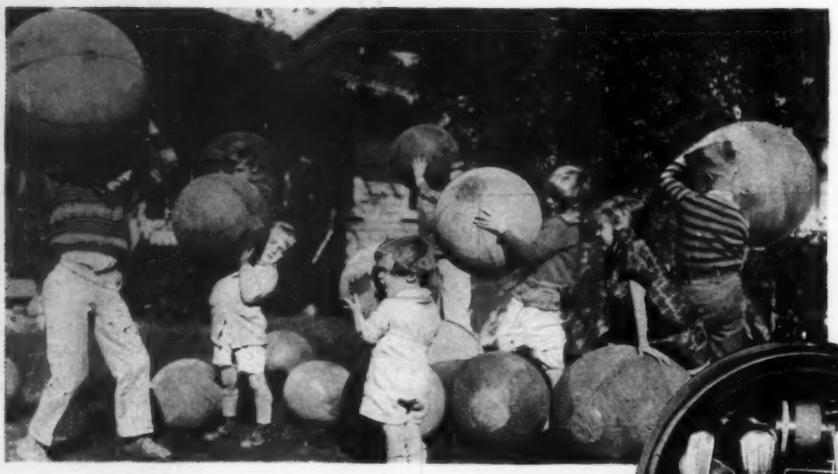
If not satisfied with what you have written with this fountain pen, you can scratch it out with the folding knife blade which is set in the other end

Hikers and others on highways at night may protect themselves from motor cars with the electric signal light for hats, shown above. The "ornament" at the front is a bulb with a reflector, connected by invisible wires with a control button at the end of the ribbon on the girl's shoulder. A man would wear the button in a lapel of his coat

A new magnifying instrument can be attached to any desk, as shown below, for use as a microscope. By insertion of objective lenses of various powers it becomes a powerful telescope. The tube of the telescope serves here as a standard. For telescopic work, the support would be the bar that holds the microscope. The instrument can be closed so compactly that it may be carried in the pocket



To test a bulletproof vest of his invention, Louis Wisbrod, Chicago, "shot himself" repeatedly with an automatic pistol. He is seen at the right examining the flattened bullets and wearing the vest that stopped them. The garment, which is made of Swedish steel, is one thirtieth inch thick and weighs only three and a half pounds



A group of Los Angeles children playing with large rubber balls made out of old auto tire tubes by Mitchell Carter

Big Balloons from Tire Tubes

HERE'S a new way to utilize the discarded inner tubes from your motor car's tires. Mitchell Carter, a Los Angeles inventor, recently conceived the idea that they might be made into toy rubber balloons for children. He tried his scheme, and it worked admirably, becoming the joy of the neighborhood.

So popular were the first balls he turned out from his old tubes, that he had to make others for children blocks around. As the photograph shows the balls are of many sizes. Now he may try to patent the idea and profit from his ingenuity.

"White Terror" of Sea Ended

COLLISION with an iceberg off the coast of Labrador recently cost the Canadian steamship *Montcalm* a new propeller blade—a minor accident the more noteworthy because it was the first reported mishap from this cause in the fifteen years since the International Ice Patrol was established!

Ever since the tragic sinking of the *Titanic* in 1912, the potential menace of these floating mountains of ice has been realized. When the United States took the lead by designating two cruisers, later replaced by the cutters *Seneca* and *Miami*, to ice patrol duty in the North Atlantic, other nations met in conference and agreed to share the expense.

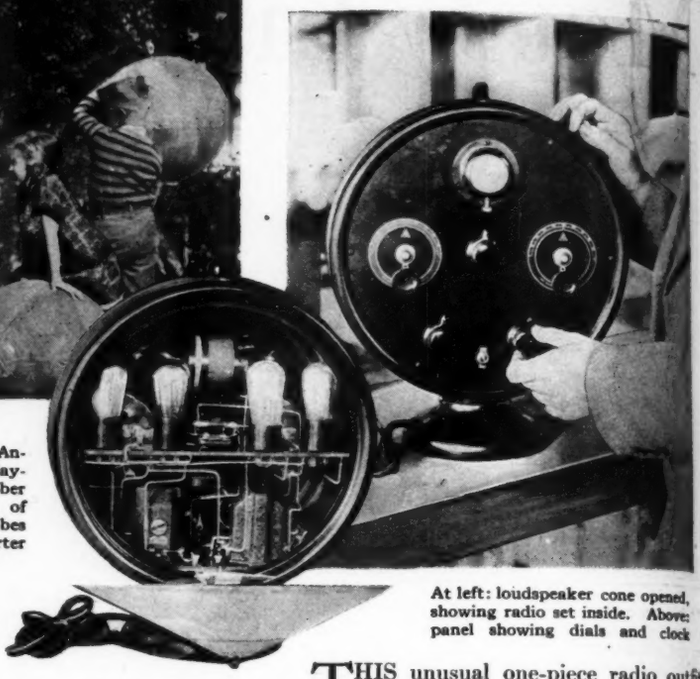
Now patrol officers guard the moving ice floes as far north as the ship lanes cross, and broadcast radio reports twice daily to all vessels. Special radio warnings follow the discovery of new bergs; and warnings from other ships are relayed by the cutters.

The northernmost ship lane of all is still filled with ice islands; but here the danger is known and avoided by reducing speed, as did the officers of *Montcalm* shortly before she grazed a sunken floe—so gently that little damage was done. The "white terror" is a thing of the past.

Ask if You Want to Know

POPULAR SCIENCE MONTHLY is always glad, whenever possible, to answer all of its readers' questions on technical or other problems that are within its scope. Any inquiries should be addressed to the Information Department, Popular Science Monthly, 250 Fourth Avenue, New York City.

Radio Set in Cone Speaker



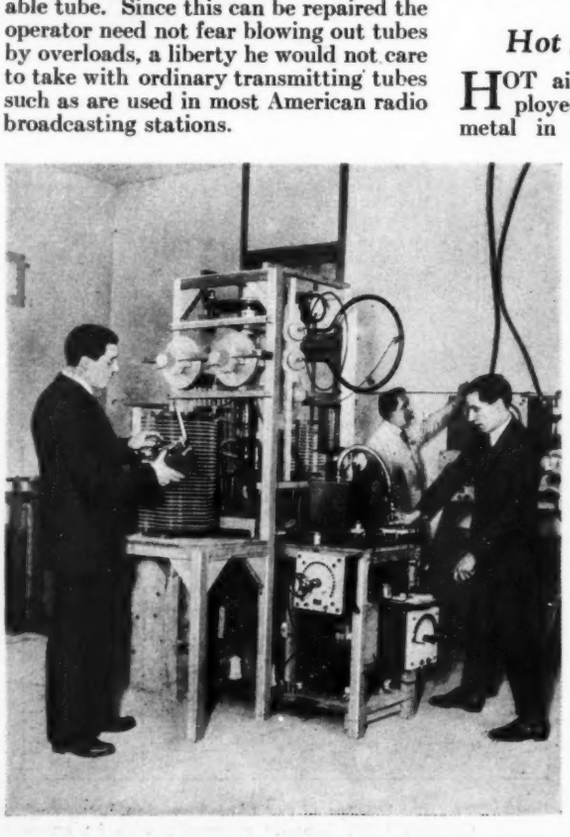
At left: loudspeaker cone opened, showing radio set inside. Above: panel showing dials and clock

THIS unusual one-piece radio outfit was designed by an Ohio inventor, who claims for it compactness, portability, and economy of construction. The set is built inside an aluminum drum, which houses the receiver and is a frame for the loudspeaker cone. The tone may be modified by altering the position of the cone. The back side of the drum contains the dial panel, and includes a clock.

The set weighs less than ten pounds, and thus is easily portable.

Power in Short Wave

M. DESCARSINS, French Army radio engineer, has developed a radio transmitting circuit in which he can employ as much as twenty kilowatts of power on a forty-five-meter wave. Russia, India and South America have reported hearing signals from his station. The means of obtaining such power is a modified form of the Holweek demountable tube. Since this can be repaired the operator need not fear blowing out tubes by overloads, a liberty he would not care to take with ordinary transmitting tubes such as are used in most American radio broadcasting stations.



The French radio broadcasting station, which, using special tubes, employs power up to 20 kilowatts on a wave length of only 45 meters and has been heard in India and South America. At the left an operator is testing the wave length with a wave meter

Hot Air Polishes Metal

HOT air is the unusual agent employed for highly polishing plated metal in a recently devised tarnish-removing process. After nickel-plated articles have been cleaned in a special bath, they are placed in a wire basket that whirls at high speed while a pipe blasts hot air through it. The metal is dried and brought to a high polish in this single operation, saving considerable labor and expense in the finishing process.

Snakes Outwitted

PREVALENCE of snakes, scorpions and similar pests in Egypt has led farmers there to devise a novel method of safe sleeping during the hot summer months. They build huge round urns of baked mud outside their homes.

The urns are shaped with tapering bottoms and large rims, and at night the whole family can climb into them, quite confident that the slippery sides will keep snakes and other disturbers of their slumber at a safe distance.

"Electric Eye" Gives Burglar Alarm

TWO new burglar alarms have recently been perfected by inventors in widely separated corners of the world.

Using a new kind of supersensitive electric cell, which responds to the light or shade falling on it, Dr. Robert L. Burt, of the California Institute of Technology, has devised an alarm that is said to give instant warning when anyone enters the room.

Light from a concealed lamp in the corner is reflected about the room by mirrors, making a network of beams, all of which end upon a single photo-electric cell. Should an intruder walk in front of any beam, interrupting it for a second, even this slight change in the total amount of light falling upon the sensitive cell will release the mechanism that rings the alarm. The bright rays of a safecracker's flashlight will also operate the cell.

The inventor says the system can be made to work on a beam of ultra-violet light, which would make the protecting network of rays invisible to the person breaking in.

A German inventor has perfected an alarm which is declared to be practically infallible and also economical by applying two recently discovered electro-physical principles. The alarm is so sensitive that merely touching the object guarded, or perhaps even the approach of an intruder, will set it off.

The first principle is that of "pre-magnetizing," which causes the metal core of an electro-magnet after being magnetized by a powerful current, to maintain its magnetism as long as a much lighter current is passed through the coil. The second principle is that a good conductor, such as metal, can be made to adhere to a poor conductor, such as wood, by maintaining a weak electric current between them. Combining the two, the inventor made a device which can be wired to any valuable object and operated by a single flashlight. When the object or any part of the wiring is touched, a short circuit is caused. This demagnetizes the core and trips an alarm.

The ingenious burglar alarm invented by Dr. R. L. Burt, of California, is demonstrated below. Fixed mirrors, like that in the operator's hand, situated all around the room, reflect light into the alarm box, as his does. If an intruder's shadow or a beam from his flashlight interrupts the reflection, a photo-electric cell rings the alarm

Above, Walter Blut, German engineer, is setting off his burglar alarm by holding an electrified celluloid rod near it. This device, which depends on two newly discovered principles, "pre-magnetizing" and "electrical adhesion," is operated by a single small dry cell. When any part of the apparatus is touched, a short circuit causes an alarm to ring

Does Earth Turn on Core?

THAT the crust of the earth twists slowly on the planet's internal core, as though the skin of a orange were loose and rotated around its inside portion, is the suggestion of Professor Bruno Meyermann, of the University of Goettingen, Germany. One rotation of the outside skin of the earth is made, Professor Meyermann believes, in about 270 years. Much scientific evidence which has come to light the last twenty years indicates the probability that between the solid outer crust of the earth and a solid central core there exists a layer of relatively fluid rock, which yields slowly, as wax does under pressure.

Gallons of Coffee a Second

EVERY second Americans drink 75,000 cups of coffee! That is the amazing estimate of Cyrus F. Blanke, St. Louis, tea and coffee importer, based on a study of data for the first five months of 1927.

We consume 121 billion cups of coffee a year, he declares. More than a billion and a half pounds of coffee, and a hundred million pounds of tea, will be used to satisfy America's 1927 thirst for beverages, the figures indicate.

A Garden on Shelves

YOU don't need a back yard to grow table vegetables, according to Mrs. C. A. Alcott, of Alhambra, Calif. She has had built several unique "vertical gardens," in which she grows successfully strawberries, carrots, onions, radishes, and spinach. The boxlike frames she uses are filled from the top with rich soil; seeds are planted down the sides in each of many inclined tiers, and vegetables sprout from all sides, growing as if on inclined shelves.

How Mrs. C. A. Alcott, of Alhambra, Calif., saves garden space by growing vegetables on sets of slanting shelves

Trailing Will-o'-the-Wisp

NOW that Dr. W. W. Coblentz and his staff of experts at the U. S. Bureau of Standards are making notable advances in the study of luminous animals and bacteria, the mystery of the will-o'-the-wisp—the strange, flickering light that has occasionally been seen at night over marshes—may soon be solved. Investigators have long been at a loss to account for this weird and curious phenomenon.

Spontaneous combustion of marsh gas, and also of phosphine, a gas containing phosphorus, formed by decaying organic matter in the ground, have been suggested as the cause of the ghostly lights; but neither gas will produce these effects. A Belgian chemist, Leon Dumas, claims to have produced such a light with phosphine and sulphuretted hydrogen; but this is not confirmed.

Now some form of "cold light," such as that of luminous plants or animals, seems a more likely cause. Some explanations along this line ascribe the will-o'-the-wisp to swarms of insects rendered luminous by disease, birds with luminous fungi on their feathers, luminous bacteria escaping with bubbles of gas from the marshes and the luminous effect in decaying wood known as "fox fire."

Though authentic observations of the will-o'-the-wisp, or *ignis fatuus*, are very rare, there are a few of particular interest. In some marshy woods near Grupont, Belgium, a retired army surgeon, Jules Rossignol, saw several particularly fine displays. Little white clouds, rising from the ground, became luminous globes at an altitude of about forty feet, remaining visible for several minutes. Matthew Luckiesh, a prominent American illuminating engineer, saw great numbers of the mysterious lights while passing temporary pools of shallow waters in a Nevada desert. Prof. L. A. Hausman of Cornell University observed a fine display near Cayutaville, N. Y.

Hailstones Big as Baseballs Puncture Auto Tops

HAILSTONES as big as baseballs fell in a recent Canadian storm near Cochrane, Alberta, according to reports. The spheres of ice, some described as four inches in diameter, worked costly havoc, tearing down telephone wires and puncturing automobile tops.

That hailstones of extraordinary size do occur on rare occasions is an unquestioned fact, though scientific records to date have placed the maximum diameter nearer three inches. The largest are composed of alternate layers of ice and solidified snow, thought to have formed about an original center of a bit of gravel or dust floating in the air. The powerful wind currents of a thunderstorm or tornado, it is believed, carry them up and down many times between the "rain region" and the "snow region" of the sky, until their growing weight causes them to fall.

Last year Dallas, Texas, suffered a sensational hailstone bombardment that did $2,000,000 damage. Windows, electric street lamps and signs were shattered; even slate and shingle roofs suffered. Annual damage to farm crops from hailstones is large, and the total loss of all kinds each year from hail is about $47,000,000. No part of the country is immune from the falling missiles, whose descent is usually limited to the middle of a thunderstorm's path.

Balloon Sets Distance Record

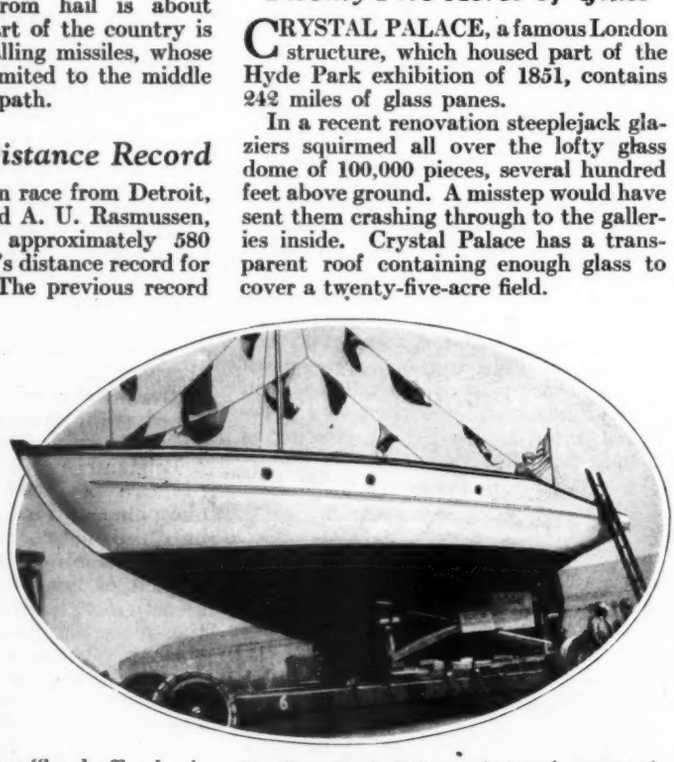
IN A recent balloon race from Detroit, the winner, Svend A. U. Rasmussen, of Detroit, soared approximately 580 miles to a new world's distance record for craft of his class. The previous record for balloons of this "third category"—42,400 cubic feet capacity — was 500 miles. To become official, the new record must be confirmed by the International Aeronautical Association.

Shipyard Built Far from Sea

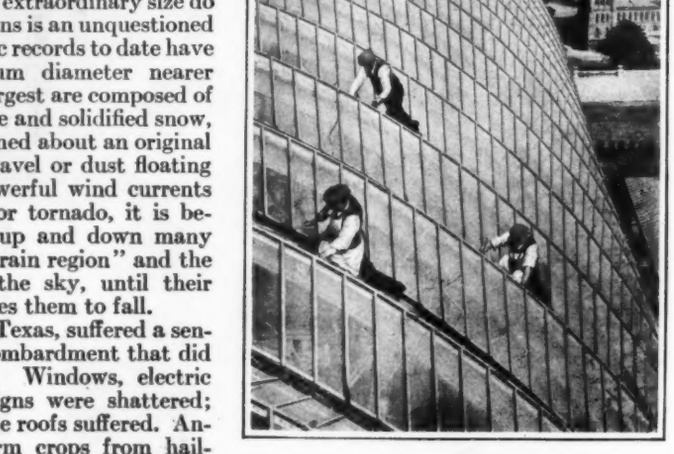
BUILDING ships half a mile from the nearest water is the unusual practice at a dry land shipyard which is doing "land office business" in San Francisco, Calif. After each craft is completed, it is swung by a huge crane on a special motor truck trailer and driven to a waterfront pier. There another derrick picks it up, holds it in mid-air while it is christened, and then sets it down in the water.

Four such forty-foot racing yawls as the *Mary Beth*, with masts and auxiliary motor installed, and one thirty-two-foot motor cruiser complete with lifeboats and motor, traveled down to the sea in this unique fashion during the first five months of the shipyard's operation.

The *Mary Beth*, shown in the photograph above, is owned by Fred Varney, of the San Francisco Yacht Club.



The *Mary Beth*, 40-foot racing yawl, on a truck trailer preparatory to hauling her from the dry land shipyard in San Francisco to the water, half a mile away. There she was christened as a derrick lifted her and dropped her in her own element



Twenty-Five Acres of Glass

CRYSTAL PALACE, a famous London structure, which housed part of the Hyde Park exhibition of 1851, contains 242 miles of glass panes.

In a recent renovation steeplejack glaziers squirmed all over the lofty glass dome of 100,000 pieces, several hundred feet above ground. A misstep would have sent them crashing through to the galleries inside. Crystal Palace has a transparent roof containing enough glass to cover a twenty-five-acre field.

New Radio Time Signals Keep World in Step

TWO new radio time signals, twice a day, on shorter wave lengths than any previously used—24.9 and 37.4 meters—have just been instituted by the U. S. Naval Observatory, Washington, D. C. With those already in effect at Washington, at Greenwich, England—the world's time center—and at other points on the globe, they will distribute "standard time"—one of the most important services astronomy can render.

Your watch is set by standard time, either directly by these signals or indirectly through local clocks. The world's business is transacted on standard time, flashed by radio to all corners of the earth. And to mariners and air pilots standard time is a matter of life and death. Knowing the exact hour, they can compare local sun time, observed with a sextant, and compute their position. Since time and longitude are definitely related, both are reckoned from Greenwich meridian.

Through powerful telescopes, astronomers here and abroad watch the movement in the sky of certain "clock stars," whose schedules have been computed with hairbreadth accuracy. As one of these stars reaches a predetermined point in the heavens, the time of its arrival serves to set the delicate clocks that keep time between each two of these "transits." All United States time signals are based on the "Greenwich mean time" of these stars' movements. The Eastern Standard time signals sent out by the Naval Observatory, for instance, are exactly five hours later than Greenwich time, due to the difference in longitude of seventy-five degrees or five twenty-fourths of the earth's circumference.

Root Grows Like Duck's Head

NATURE sometimes produces strange freaks, and one of the queerest is the tree root pictured below, recently picked up in Richmond Park, London. The extraordinary resemblance to the neck and head of a duck puzzled even the hen, which, wandering aimlessly across the grass, came upon the phenomenon and stopped in bewilderment to examine it. If the curious root had lain undiscovered, perhaps to become fossilized, one can imagine the perplexity of scientists coming upon the fossil a thousand years hence; although, of course, critical examination would show that the curiosity was of vegetable origin and its shape a result of chance in the circumstances that affected its growth.

A new kind of fowl bewildered this hen, which couldn't quite figure it out when it was set up to fool her. It is a root, strangely grown in the shape of a duck's neck and head, and picked up in Richmond Park, London

"Puncture-Proofing" Tested by Uncle Sam

ARE "puncture-proof" compounds for automobile and bicycle tires true to their name? Sixty-five of these preparations are the subject of a recent report of the U. S. Bureau of Standards. Relatively small punctures, says the bureau, may be plugged more or less permanently by the best of them, and porous tubes sealed; large punctures, cuts, blow-outs and "pinched" tubes need other remedies. Two advantages claimed—that they preserve the rubber, and prevent escape of air through leaky valves—are declared questionable.

Driving a nail into a tire injected with a compound—a startling test suggested by several makers—is of slight significance, says the bureau. When a tire is stationary, almost any "puncture-sealing" compound will plug a nail hole. But a tire on a moving wheel, continually being stretched and compressed, is harder to seal against air leaks.

Most "puncture-proof" compounds contain a finely-ground fiber or flaky material, such as asbestos or mica, and an antifreeze material. When a puncture occurs, escaping air crowds the fiber into the hole and plugs it. Some compounds are said to harden to form a seal. This can only happen slowly, after the fiber has stopped the leak.

Eagles Trained to Hunt

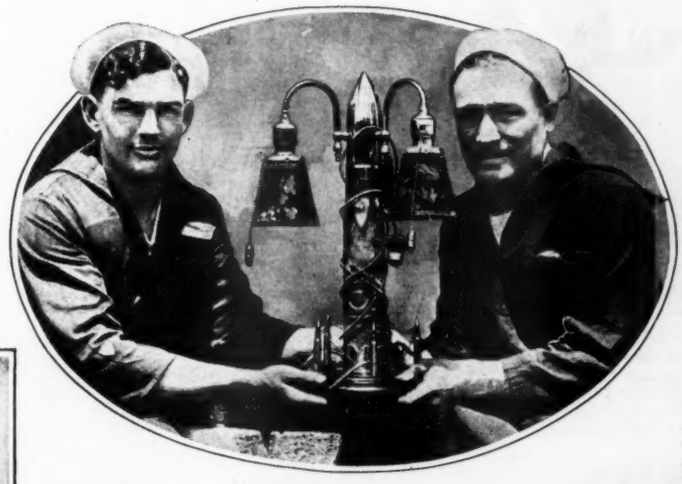
PERHAPS the only place in the world where the eagle is a domesticated servant of man is in the scarcely known district between the Caspian and Aral Seas in Central Asia, where it has been recently found that the semicivilized Kazak nomads tame the birds and teach them to hunt. The birds are known as "berkoots," and are ten times as valuable as horses. An annual market for the trained berkoots is widely attended.

The berkoot soars aloft and spots a wolf, a fox, or other smaller game, then swoops down and captures it by pecking out its eyes and crushing its bones.

An Asiatic Kazac nomad's eagle alighting on his arm. The birds kill game for the owners and are ten times as valuable as horses

Toy Soldier Many Ages Old

WHAT was the first toy soldier? This remarkable pottery plaything, recently discovered in a burial mound near Ixtlan, Mexico, claims the title. Archaeologists estimate its age at thousands of years. It is believed to have been made by the ancient Toltecs of Mexico. This would make it antedate the Aztec civilization destroyed in 1519.



Lamp Made of Gun Shell

FROM a cannon's muzzle to a library center table is a long jump, but that is the evolution made by this six-pounder naval shell, with the aid of two dexterous and industrious sailors.

The library lamp is the product of one week's labor by these two sailors from the U. S. S. *Cunningham*, a destroyer stationed at the Charlestown Navy Yard, Boston.

After the large six-pound shell was used as the center standard of the lamp, rifle cartridges and revolver bullets were utilized for ornaments. All of the shells were empty. The lamp was fully wired, engraved with naval insignia and given a high polish.

Atoms Smashed at Last, Scientists Declare

WITH the aid of radioactive substance such as "Radium C," one of the solid products of decaying radium, and "polonium," another related substance, atoms can now be pulverized, according to G. Kirsch and H. Pettersson, who recently told the Academy of Sciences at Vienna, Austria, that they had successfully bombarded pure carbon—the principal element of coal—with the radioactive rays.

The fragments of carbon atoms which they say they obtained, in small but definite quantities, consisted principally of lighter hydrogen atoms. Oxygen, too, could thus be broken down, they asserted. But science generally still doubts the actual breaking up of atoms.

Raindrops' Measures Taken

HOW big are falling raindrops? The difficult task of measuring their size has just been performed by J. J. Nolan and J. Enright, of University College, Dublin, Ireland.

According to the average they found, it would take 312 raindrops laid side by side to make an inch. A very few reached ten times this size. More than three thousand drops were measured.

Nerves at Work Get "Het Up"

WHEN you burn your finger does your brain learn it by a sort of radio or electric wave that transmits the message through your nerve system? That was the old belief, based on the fact that stimulated nerves had never been found to give off heat.

New researches by Dr. A. V. Hill, of Cornell University, have shown that the opposite is probable—that an impulse traveling along a nerve is a high-speed chemical reaction. Using an electric heat-measuring device to record temperature changes of one twenty-millionth of a degree, he found that a nerve gives off a minute quantity of heat when it reacts.

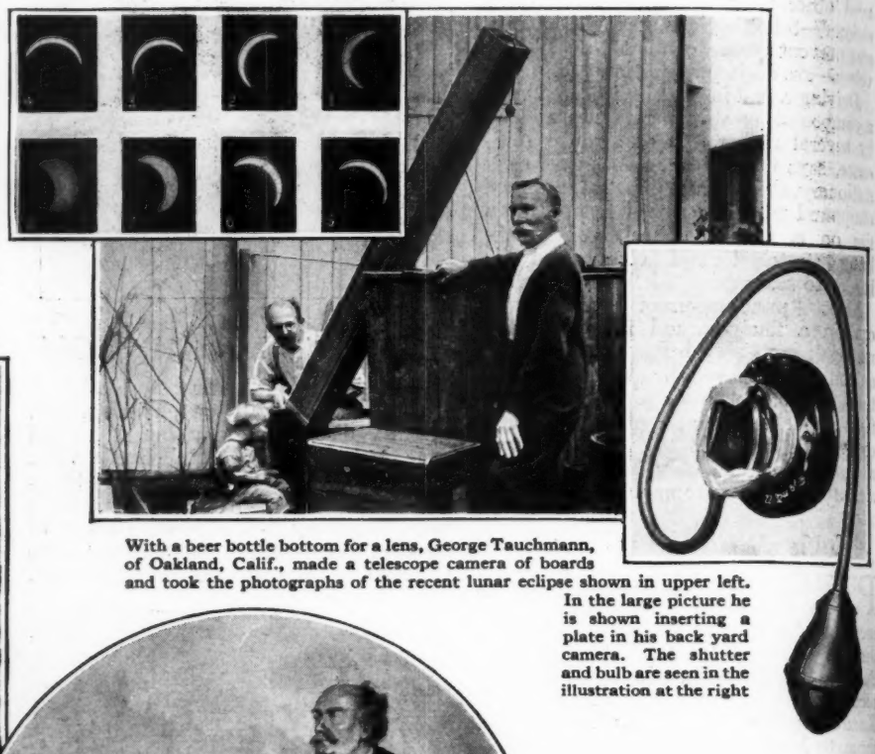
All Bride's Attire Synthetic

SYNTHETIC materials recently made up the wedding costume of a West Virginia girl, exhibited later to the American Chemical Society. It cost but $25. All was artificial, from the tulle veil to the silver-rayed slippers. Dress, stockings and lace were of rayon made from wood and cotton. Threads of a tin-copper alloy were the "silver" slipper decorations; collodion beads completed the outfit. Even the prayerbook and the traditional garter were of artificial materials.

Unique Activities

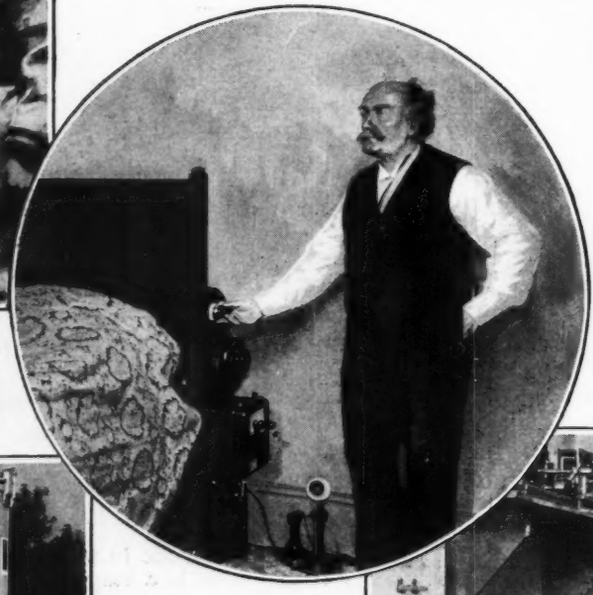
Pygmy Castle and Telescope Made from Bottle Only Two of Many and Varied Novelties

Production of petroleum from some fields is unprofitable because of its high content of sulphur, harmful to gasoline engines. Gladys E. Woodward, Northwestern University chemist, is working on a method of removing the sulphur

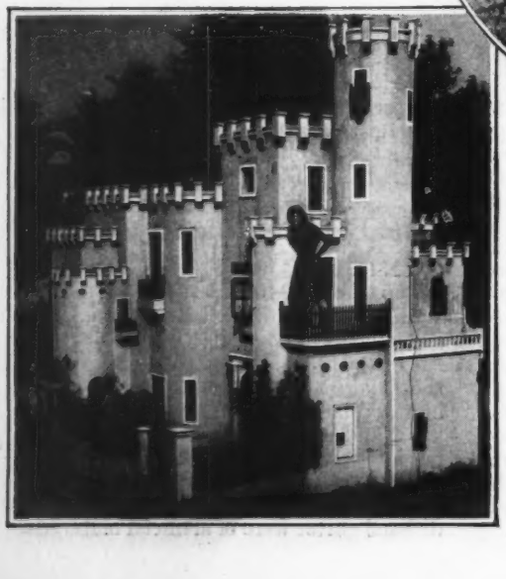


With a beer bottle bottom for a lens, George Tauchmann, of Oakland, Calif., made a telescope camera of boards and took the photographs of the recent lunar eclipse shown in upper left. In the large picture he is shown inserting a plate in his back yard camera. The shutter and bulb are seen in the illustration at the right

The world's youngest deep-sea diver, according to his claim, is George Knight, of Brighton, England, being congratulated here by the Brighton Harbor Master after descents in gear weighing two hundred and twelve pounds. He is fifteen years old



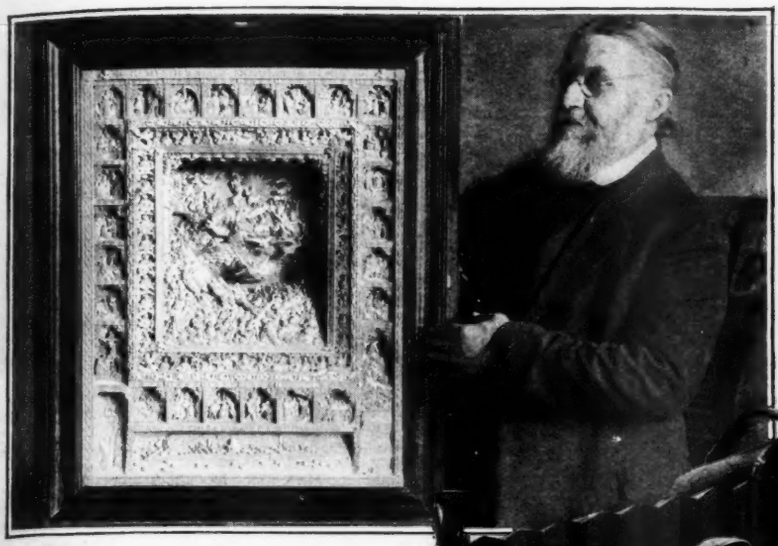
Here is the "rockingbed" described in the September POPULAR SCIENCE MONTHLY, that Sir Alfred Yarrow, British physicist, shown at the switch, had built for him to duplicate the swaying of a railroad train, which he found relieved his insomnia. Even slight jolts are reproduced and the bed can be set to "run" at any "speed" desired. Electric motors furnish the power



Not a doll's house but a doll's castle is this, built by Alex McLean, of Alhambra, Calif., who is showing it to a visitor. The kitchen is four feet square and the "stronghold" is built and luxuriously furnished to scale. In most of the rooms one has to stoop, and one must go through doorways sidewise. It took the California pioneer a summer to complete the castle

Above is Dr. Alexander Meissner, German radio engineer, demonstrating his recent invention, an electric motor whose rotating part is a plate of quartz crystal. Connected in a radio circuit, the crystal vibrates and sets up air currents that cause it to spin. Interesting scientific applications of the device have been suggested

of Unusual People



A passion play and more in wood is this intricate carving depicting the birth, life and crucifixion of the Christ, the result of fifteen years' labor of Gemanas Nikodimow, a Greek monk seen above. It is all of boxwood. Distinguished Greek artists have appraised the work at $200,000, but so far the carver has refused all offers to buy the masterpiece

Miss Pearl Ruth Sherman is just twenty-one and runs her own drug store in Philadelphia, Pa., where she is shown mixing and grinding medicine in a mortar. In 1924 she was graduated from Temple University as a pharmacist. She went to work, then into business, and now she is her own boss, making herself work sixteen hours a day at her profession

A motor car body in the form of a huge camera was built by Louis A. Daignault, photographer, of Biddeford, Me., and mounted on a light chassis. The interior is his dark room. The owner travels from town to town making pictures and his car constitutes an excellent advertisement of his business. There is ample room for bulky supplies and developing and printing apparatus

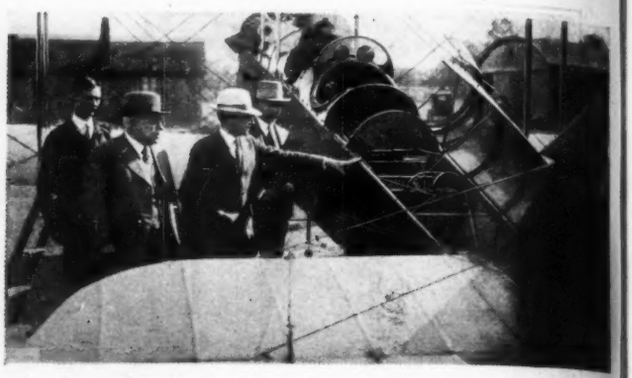
While some widows are succeeding their husbands in politics and in old established business fields, Mrs. Carl Oelze will continue to operate the San Diego, Calif., Airport, which her husband founded. And she will not conduct it altogether from the ground, either, as the photograph shows. New planes will be bought for the passenger service and more hangars will be built. Shortly before his fatal illness Oelze won attention by successfully landing an airplane by means of a parachute

Dental tools are good for something beside making teeth more beautiful. Mrs. Ann P. Wise, of Hollywood, Calif., utilizes them to cut, grind and polish delicately colored sea shells into cameos, statuettes and figurines

Rev. B. F. M. Fahl, a clergyman of Philadelphia, Pa., had a parish but no church. Recently he decided to build one himself with his wife as his chief assistant. By day both work on the structure and in the evening members of the flock, sometimes as many as two hundred, join in the labor. The only actual cost of the edifice is that of building material and plumbing. Even some of this may be donated

Latest Ideas *in* Aviation

G. S. Bousquet, of Quincy, Ill., is shown here with the midget monoplane which he is building for a flight to Washington, D. C. This baby plane will have a wing spread of only fourteen feet and, including its half-horsepower motor, will weigh only 250 pounds when completed and ready to fly



A radio receiver in the airplane fuselage responds to signals from the ground and flashes lights on the instrument board, telling the aviator if he is on his course. Drs. George K. Burgess and J. H. Dellinger, of the U. S. Bureau of Standards, are shown above examining the new device

Porous Parachute Safer

A REMARKABLE new type of life-saving parachute was successfully tested recently at the Navy's air station at Anacostia, D. C. Unlike the fabric previously used, the new silk, a special weave, has the distinction of being porous until air pressure closes its tiny orifices. Consequently there is no jerk as the parachute opens; at first the air rushes through it, then the material gradually becomes airtight and slows the falling jumper. Freedom from oscillation that results is regarded as an important advance in safety.

Balloon Can Fly for Weeks

A NEW type of balloon that could stay in the air for weeks, and travel halfway around the earth, is proposed by Lucien Bodin, a Frenchman. Besides its ordinary gas bag, filled with hydrogen gas, not quite large enough to support it alone, the craft would have an auxiliary compartment filled with air to supply the additional necessary buoyancy. By heating or cooling this air the pilot could regulate his altitude without valving off and losing any of his precious hydrogen; thus he might stay in the air as long as his food and water held out.

Such a scheme was that of Jean Francois Pilatre de Rozier, pioneer French aeronaut, who was killed in the first trial of a novel balloon he constructed. The craft caught fire and fell. Bodin's scheme, however, would avert this catastrophe by a new system of heating the air. He plans to use the heat generated chemically when the vapor of gasoline comes in contact with powdered platinum—a similar effect to that of a certain type of gas lighter for the home, containing a thin spiral of platinum wire whose catalytic action causes union of the gases and a resulting flame, except that the heated platinum would glow.

What Speed Can Man Endure?

CAN a man-built flying machine surpass in speed a man's endurance? The human factor will be the eventual limit of an airplane's velocity, according to Major Louis H. Bauer, Medical Corps, U. S. A. Future airplanes may reach a speed that will not allow a turn to be made; pressure on the side of the pilot's brain, caused by a sharp curve, would result in death. It is likely that man cannot stand such a turn at a rate exceeding 300 miles an hour, Major Bauer says, though he might be able to do considerably better on a straightaway course of sufficient length.

Air pilots are approaching this limit. When Lieut. James H. Doolittle, army aviator, recently performed with his plane an "outside loop" for the first time in history, he is believed to have attained a speed of 350 miles an hour! The spectacular feat began with a nose dive straight down, reversing the usual method of "looping the loop." The strain of the sudden turn is said to have distended the pilot's eyeballs until they touched his goggles.

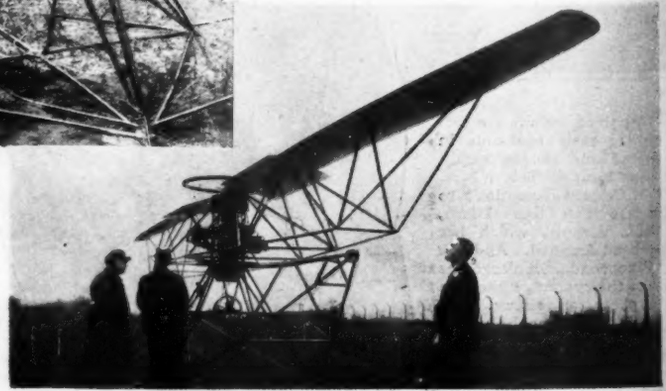
Now Lieut. Al Williams, U. S. N., seeks a new record in a special plane powered by a new 1200-horsepower, twenty-four cylinder motor.

Wings that revolve like blades of an electric ceiling fan are designed to lift this plane straight up from the ground, according to its inventor, a German aviation engineer, who tested it recently. The picture above shows the inventor and the motor-driven gyroscope that make the wings revolve

Beacons Pierce 15-Mile Fog

BRILLIANT scarlet fog-piercing lights, of the type invented by Raymond R. Machlett of New York and illustrated in a previous issue of POPULAR SCIENCE MONTHLY, are now in use at Curtiss Field, N. Y., and Hadley Field, near New Brunswick, N. J. The U. S. Bureau of Standards has made a favorable report on the new airplane beacons and if final Government tests now being conducted prove satisfactory they will be installed at landing fields throughout the country.

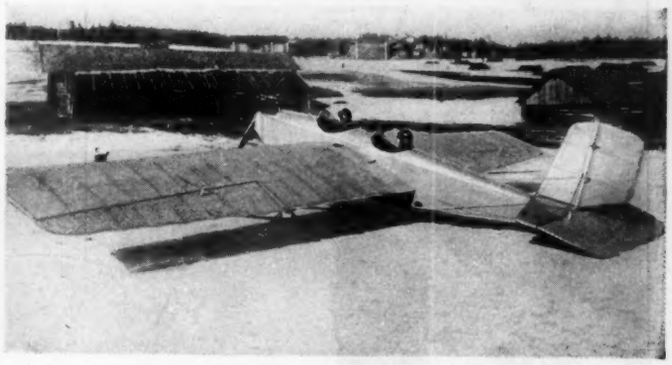
Said to be visible through dense fog as far as fifteen miles, the 10,000-candlepower lamps owe their mist-penetrating power to the long wave length of their peculiar-colored light. Such a beacon would have enabled Commander Richard E. Byrd, on his trans-Atlantic flight, to find Paris when he wandered lost in a fog above the city.



View of new German plane whose revolving wings, operated by gyroscope, are said to lift it perpendicularly, making a take-off runway needless

Flying Ambulance, Odd Birdlike Glider, Improved Parachutes and Sky Beacons; Scores of Ingenious New Uses for Airplanes

Hans Richter, famous German glider expert, is shown here ready to take off in his new motorless plane equipped with movable wings, which operate much like a bird's. The cord with which the glider is pulled to gain momentum for the rise is shown attached to the plane near the pilot's feet



Ice runners instead of wheels on the landing gear are one feature of a small airplane of novel design built and successfully used by Niilo Karhumaki, a Finnish farmer. Note how he attached the wings to the middle instead of the front of the fuselage. A 35-horsepower motor is used

TRAVEL by plane at less than rail fare is now possible, according to Sir John Rhodes, British aviation enthusiast. With one passenger, he recently completed a 1500-mile pleasure trip through France and Belgium in a small plane of the "moth" type at a cost of less than seventy dollars—including gasoline, oil, housing for the airplane, and even customs fees. Since two persons made the trip, the total cost of about four and one half cents a mile compared favorably with rail travel. They averaged fifteen miles to the gallon of gasoline—a record better than that of many automobiles.

Planes Used in 156 Ways

PURSUING and capturing law-breakers—studying eclipses of the sun—and discovering factory violators of the smoke nuisance laws are some of the strange uses for airplanes disclosed by a recent survey directed by William P. MacCracken, head of the new civilian aviation branch of the U. S. Department of Commerce. In all, 156 different services rendered by planes have been found, of which only thirty-two are military or naval.

In mining, agriculture, exploration, sport, architecture, fishing, forestry, and scientific research the airplane has proved a valuable ally. Planes are used to chase other planes smuggling liquor, aliens and narcotics; to rush precious stones from mine to market without fear of hold-up; to scout for schools of fish, and to make crop surveys.

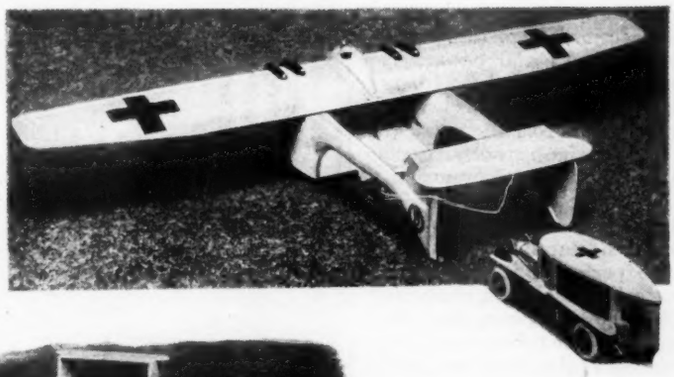
From a soaring plane, river traffic and dredging work, as well as tides and currents, may be observed and studied. City and suburban planning is done with the aid of airplanes and the view obtained from them. Upper air currents are studied from airplanes, and eclipse observers use aircraft to obtain a view unobstructed by clouds.

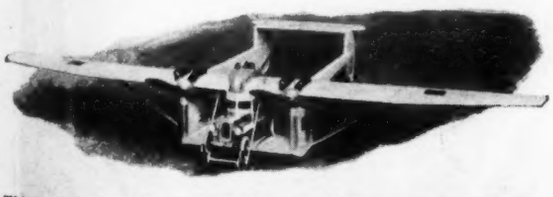
Among the others are such novel uses as hunting lost animals on ranches; locating refugees in flood areas; transporting payrolls; chasing rum-runners, and spotting forest fires.

New American Air Lines

IS AN air mail service across the ocean to Europe likely soon to become a fact, instead of, at present, a fascinating possibility? A few days ago, Second Assistant Postmaster General W. Irving Glover announced the Post Office Department would establish an air route over the Atlantic at the first opportunity, and that schedules probably could be maintained with regularity. Such a route, it has been pointed out, would probably be via Bermuda and the Azores, with stops for fuel. As a commercial venture, the line would operate at a handsome profit under present air mail rates.

Meanwhile, America has awakened to the possibility of travel by plane and new airlines are being opened daily. Besides the airways shown on the map published in the September issue of POPULAR SCIENCE MONTHLY, a transcontinental air express service is now to link New York and San Francisco. New passenger lines are planned—among them, a Detroit-Cleveland line, another to carry travelers from Indianapolis to Chicago, Cincinnati and other cities; a line to connect Spokane, Wash., with Seattle and with Portland, Ore., and in the East, a line from Portland, Me., to Boston, and another to the Maine lakes. On a newly established airway, passengers may now take advantage of regular flying service to Duluth and Superior, Minn.





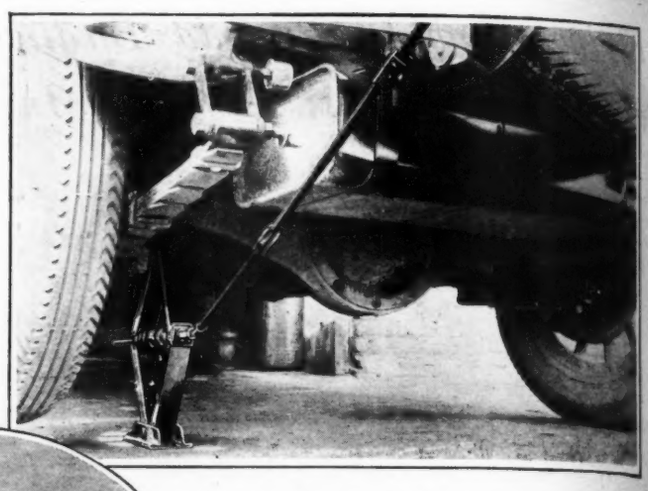
This model of a remarkable aerial and land ambulance for military use was exhibited recently in Berlin. As shown above, a motor ambulance fits between twin fuselages of a specially constructed plane, where it is securely attached so that it can be transported quickly by air to a battlefield or wherever else it may be needed

How the streamlined aerial ambulance climbs aboard the transporting plane. The twin nacelles of the plane are joined by a platform which serves both as an inclined runway for the ambulance, and as a support for the car in flight. In boarding the plane, the ambulance simply drives under the tail and up the platform. At its destination it quickly backs to the ground

Reveals How Birds Fly

NOW the secret of a bird's perfect flight is to be a secret no longer. A new instrument invented by Huguenard and Magnan, two French students of aerodynamics, may be attached to a bird's back and used to record its motions in the air with perfect accuracy.

As recently announced before the French Academy of Sciences, the device weighs but two ounces—as compared with twenty-eight and a half pounds for a similar device the same two men invented to study the wing movements of airplanes. Strapped to the back of a pigeon or other tame bird, it will register simultaneously on a smoked chart how far up and down the bird's wings move, how fast it is traveling through the air, and how many strokes a minute its wings are making. Records of this kind may be of great value in designing future airplanes.



He Swims by Machinery

IF YOU don't know how to swim, this "aquabike" may solve the problem for you.

A pair of bicycle pedals driven by the feet rotates a small screw propeller at the submerged end of the device. Floats on the arms and one at the end keep the rider on the surface of the water.

The aquabike was invented by Henry Uberto, of New York City, whose shoulder was disabled in the World War, preventing his swimming like other men. To overcome his difficulty, he perfected the bike. The photograph above shows Mrs. Uberto holding the device aloft, while the other shows the inventor riding his machine in the water.

KNOW YOUR CAR

A LITTLE care often will safeguard you against the possibility of punctured or blown-out tires. A large percentage of flat tires are not caused at the moment the tire runs over the puncturing object. In most cases, the tack or nail is lying on the road in such a position that its point is not aimed directly upward. As your tire rolls over it, the point may catch in the rubber and the tack may travel around on the tread for many miles before the repeated pounding on the road finally forces it through the tread and tube.

That is why it pays to inspect your tires daily to find tacks, nails, pieces of glass or other sharp objects that may be hanging on to the tread in such a way that they will eventually work through and cause a puncture.

A Distillery for Steel

STEEL will melt, boil, and finally evaporate in an amazing electrical furnace, which does not create enough heat to scorch a piece of paper!

The furnace resembles a glass bell such as many restaurants use to cover doughnuts. Inside the bell is set up an electric coil through which a strong current reverses itself 30,000 times a second. The coil is surrounded in the bell by a partial vacuum. This rapidly oscillating current creates "sympathetic" currents in any metal placed near it and causes the metal to break down and evaporate in gaseous form. The picture at the right shows the apparatus melting ten-pound steel bars inside the bell while a chemist nearby controls the current.

The device has been named the high frequency vacuum induction furnace by P. H. Brace, of the Westinghouse Research Laboratories, who perfected it. The furnace is valuable in studying the impurities contained in metals. The tube seen at the bottom of the stand on which the furnace rests sucks the metallic gases out of the bell as they form. They can then be isolated and analyzed at will. By such a method of analysis, more and more is learned of the impurities in steel, and the manufacture of stronger and more durable metals is made possible.

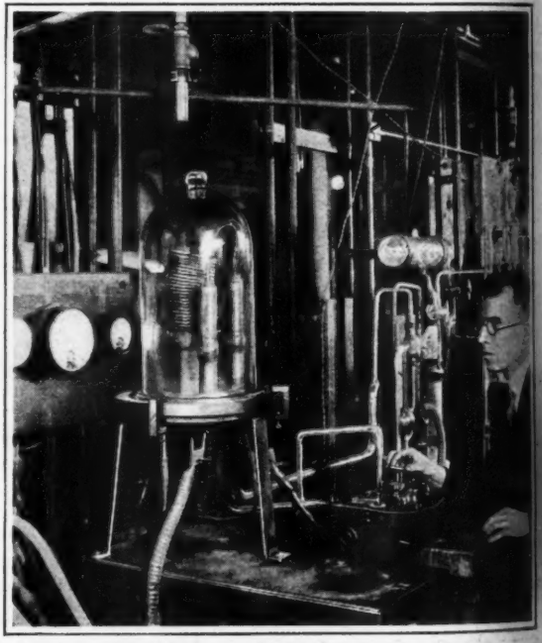
Auto Jack Always in Place

SOMETHING new in auto jacks are these individual wheel lifters. You don't need to hunt through the tool chest for your jack, and then get down in the mud to put it in place beneath the axle—for each of the new set of four jacks is permanently bolted on to the axle of the car near the wheel it raises.

Here it takes up only four inches of space in its folded position; but for changing a tire the device is instantly expanded to full height, lifting the wheel off the ground. A convenient long-handled wrench, which is hinged to fold into a small space in the tool box, operates the jack at a safe distance from the greasy underbody of the car, through a nut at the front of the jack.

High Pressure to Crush Eggs

TO CRUSH an eggshell so delicately that the inner membrane would be unbroken, a pressure of fifty-one pounds had to be exerted by a giant testing machine at the Bureau of Standards in Washington, D. C.



Thirty thousand electric vibrations a second in the coil in the partial vacuum inside this glass bell convert steel bars into gases, which the tube draws out for scientific study

"Flying Doughnut" Plane Crashes in Test

WHEN a remarkable "flying doughnut" airplane with four circular wings recently attempted to take the air at Curtiss Field, N. Y., a crash ended the short experiment. From a height of three feet the odd craft, described in the September issue of POPULAR SCIENCE MONTHLY, fell, struck a bump, and collapsed. Emil Rupprecht, the Curtiss Field test pilot who tried to fly it, jumped clear as the whirling propellers ripped the silk fabric and fragile wood structure to bits. He escaped with a severe shaking-up.

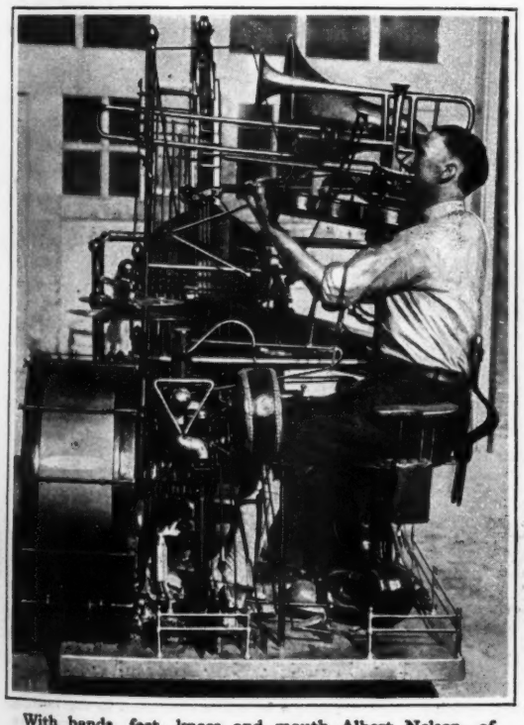
Known to flying men as an "annular," the plane was patented by Dr. George F. Meyers, of Jackson Heights, N. Y., in 1897. Five propellers powered by a two-cylinder motor were intended by the designer of the plane to provide both forward propulsion and direct lifting force.

A Real "One-Man Band"

HE'S a twenty-two-piece orchestra all by himself!

This labyrinth of horns, drums, tubes and strings is really a highly intricate musical assemblage, the result of seven years' work by Albert Nelson, of Minneapolis, Minn. Only the inventor is able to master it, but when Nelson gets his hands, knees, feet and mouth to going all at once, the results are said to approximate an orchestra of over twenty pieces.

The assemblage contains parts of automobiles and locomotives, as well as many wind, string, and percussion instruments. An electric amplifier is used by the inventor to magnify the sounds of the stringed instruments so that they are not drowned out by the heavier brasses and drums.



With hands, feet, knees and mouth Albert Nelson, of Minneapolis, plays this twenty-two-piece orchestra, containing almost every kind of wind, string and percussion instrument, which took him over seven years to build

Above: Trainmen and dispatcher students studying for London subway positions in the secret tunnel that hid British Crown Jewels during the war. At left: Students examine signal chart

Railway School Underground

BENEATH the ground of London, England, in a secret tunnel that hid Crown Jewels and paintings of the London National Gallery during the war, is probably the strangest subway station in the world. No train ever has entered it; but on its seventy feet of standard subway track engineers and signal dispatchers of the London Underground Railways learn the intricacies of underground railroading.

Graduates of the remarkable subway school, recently built in the ready-made tunnel, are prepared to take immediate positions on real subway lines. There is an underground lecture room at one end with desks for sixty pupils, a projection lantern for throwing diagrams on a screen, and electrical apparatus such as is used in subway railroading. "Signal cabins" are stationed along the experimental track.

Illuminated charts on the tunnel wall display dark moving shadows that show locations of imaginary trains.

The electro-pneumatic signal system is complete and always ready for demonstration. At the end of each lecture, students are free to handle and try out for themselves the switches, the signals and the electric current devices they have just learned about in the lecture room.

Along a platform that borders the model track runs another, a miniature track on a raised runway. Here toy cars are used to show how to avert collisions and maintain the proper headway in accordance with the signals.

Eventually, it is hoped, some method of signalling may be devised so that trains may be run underground without human drivers. They would be completely equipped with safety devices that would make accidents virtually impossible.

Few Londoners except the students themselves know of this night schools' location, or even its existence. Its electrical machines are installed in the same tunnel alcoves that once were used to house the priceless jewels and valuable paintings.

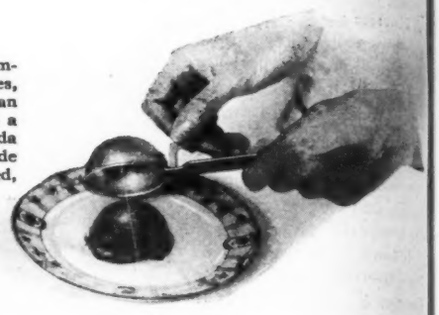
How Much Do You Know of the World You Live In?

TEST yourself with the twelve questions below, selected from hundreds sent in by our readers. For the correct answers turn to page 167.

1. Where can submarine gardens be seen in the United States?
2. How was Mammoth Cave formed?
3. Where is the ground covered with moss instead of grass?
4. Which Indians are most warlike?
5. Where does moss grow on telephone wires?
6. What is the lightest wood?
7. Why are Jersey cows so called?
8. Where do natives dye their hair red?
9. Where did Caliph Harun al Rashid of the "Arabian Nights" live?
10. What large river has no mouth?
11. What is the chaulmoogra tree?
12. What is the largest flower in the world?

Housekeeping Tools

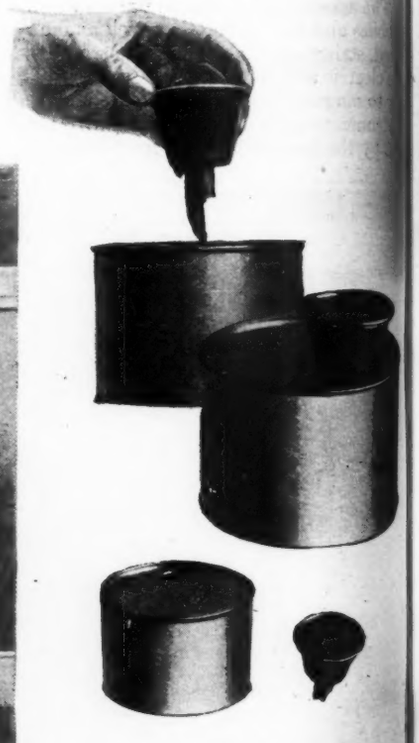
A rubber cap replaces the metal one taken from a bottle of ginger ale or other refreshment and, being air-tight, preserves what is left of the contents for future use. The deep groove lets the core go inside the bottle when you give it a twist, and allows the rim of the cap to encircle the outside of the top of the bottle



Hot and cold foods alike that lend themselves to molding—ice cream and ices, mashed potatoes and other vegetables—can be dished out in neat hemispheres with a small device similar to those used at soda fountains. A band of metal that fits inside the scoop moves when the lever is operated, loosens the portion and drops it on the plate. The device can be manipulated with one hand while the dish is being held with the other

The three aluminum kettles shown here fit inside one another so that a different dish may be cooked in each, although only one burner of a stove is required. The upper kettles may be used for steaming or boiling. Handles are insulated and do not get hot

Feed string beans into the hopper of this machine and turn the crank. This forces the beans through the knives that cut them in uniform lengths. Primarily designed for use in canning, the device is helpful as well in preparing a dinner or luncheon

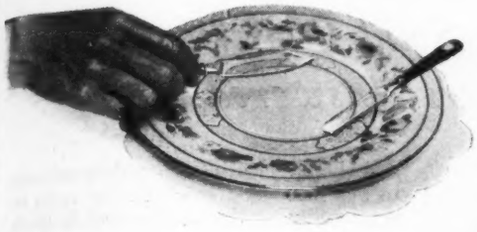


Who has not had trouble trying to fill a small bottle—such as a baby's, for example—whose mouth would not safely accommodate an ordinary funnel? Here is a device that solves the problem. The funnel is equipped with spring prongs that grip the bottle, keeping the filling device securely in place. The tension of the metal of which the prongs are made is sufficient to provide perfect security

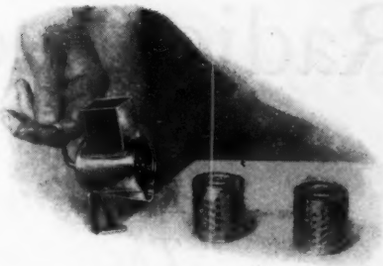
A vacuum cleaner that will tire no one is this, which weighs only eight and a half pounds, although it has a full-sized motor providing as much suction as standard-sized cleaners. Its universal nozzle is adjusted to any angle. It is handy for cleaning draperies and upholstery

A can opener, measuring cup and seal all in one is the unusual device illustrated above. The tubular steel bottom part is cut off diagonally, forming a point and cutting edge. Press it down, as the operator is about to do in the top picture, and you make a hole like that seen in the bottom photograph. Now with the cup measure out the contents of the can as needed. Fit the cutter back in the hole and the can is sealed securely against leakage

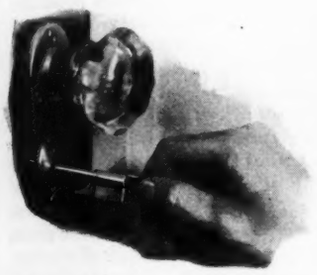
To Minimize Labor



Not stainless steel but stainless glass is the material of which the new fruit knives and butter spreaders shown at the left are made. The glass is said to be strong enough for any service required of such knives and the edges are ground to a fineness that equals that of a steel blade. They are easily washed. The ingenious designer turned to advantage his observation of the cutting power of glass

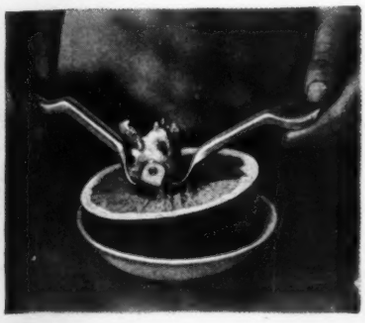


One need not clutter up a good part of one shelf or drawer with graters of various sorts to serve various purposes if one has the combination machine pictured above, which will reduce spices almost to dust and "chop" nuts coarsely, as for cake. Three interchangeable barrels, two of which are shown on the table, the third being in the machine, are fine, coarse and medium. After you have used one, it is the work of an instant to slip out the grater and replace it with one of a different size



A new "keyhole lock" enables you to render your lock unpickable when you leave the house. Inserted in the keyhole, the device grips the inside of the lock with a spring catch. No key can enter until this is removed, which is done only with the special key, as shown in the photo

Almost like a toy in size, this miniature electric range is declared to render standard service. One of the three heating units serves the oven, the others make your coffee and toast and fry your bacon and eggs. One light socket gives sufficient current. Out of use, the range can be stowed away in a trunk or on a closet shelf

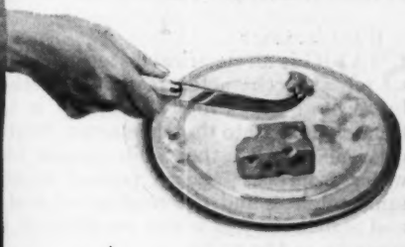


The sharp, cup shaped ends of this grapefruit core remover are hinged together. Hold the handles parallel and insert the device around the core. Then spread the handles and the two halves of the cup come together, biting and lifting out the core as shown. Holes in the cup let the juice drop through into the fruit

If you like to serve a fine sauce in the original bottle, yet want a touch of convenience and elegance, here is the way. The attractive metal holder goes round the body of the bottle and the hinged handle comes up and with fingers of spring metal grips the neck. The device is easily removable for washing

Here is a pea sheller, stamped and cut out of a single piece of metal, that saves time and energy. The cutting and stamping has made part of the metal into the odd-shaped knife in the middle of the plate, leaving a hole below. When you run the pod against this knife, it splits the pod and cuts loose the peas, which drop through the hole into the dish below. A groove guides the pods to the knife to split them in the middle

Like a drawer of a filing cabinet is this broiler of a new gas range. Instead of stooping to look in or reach in, perhaps scorching your fingers, you simply pull out the drawer, which slides easily on smooth rails. A safety bar keeps it from coming too far out and falling to the floor



Here is a cheese knife that contributes materially to convenient and dainty serving. After its cutting blade has made a neat square, the notched tip of the curved blade is used to pick it up and deposit it on the individual plate. The device can be used also effectively for serving butter. It is particularly valuable for buffet luncheons, each guest cutting his own individual portion and serving himself as he pleases

Radio Questions *Everybody* Asks

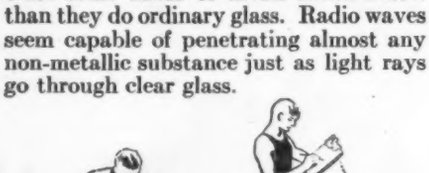
What Is Static? Why Do Signals Fade? How Can the Waves Penetrate Solid Walls? These Queries and Many Others Answered

Why do the signals fade at times?

THERE are many theories. One of the most plausible is that the radio wave from a distant station arrives at your set in two sections, one being the reflection from the upper atmosphere. Because the paths of these sections are constantly changing, the two sections are alternately in step and out. In step, they reinforce each other, producing loud signals. Out of step, they neutralize each other and the signal disappears.

Why does radio go through walls?

RADIO waves, so far as we know, are exactly like light waves except in the matter of length or vibration rate. Some hard, dense substances, such as glass, are transparent to light waves, while still shorter waves known as X-rays penetrate some kinds of metal much better than they do ordinary glass. Radio waves seem capable of penetrating almost any non-metallic substance just as light rays go through clear glass.



The distance from the peak of one wave to the peak of the next is the wave length. The number of waves that pass a given point in a second specifies the wave in kilocycles

What keeps stations from getting mixed?

Each station broadcasts on a slightly different wave length, which means the electrical vibrations sent out by the stations are at different rates. You receive any particular station to the exclusion of the others by putting your set in tune with its particular vibration rate.

What is static?

STATIC is an electrical disturbance of a vibratory character created in the ether by natural forces and apparently is intimately related to thunderstorms. Static gets mixed with the radio signals like water from two glasses poured in the same pitcher, and the mixture of static and signals is just about as difficult to separate as the water.

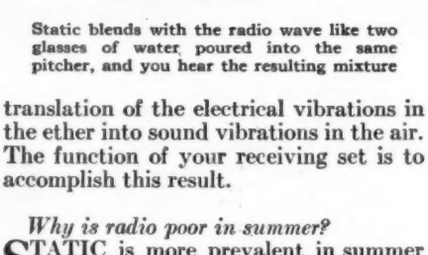
What happens to sound when it is broadcast?

Broadcasting consists of continuous, wavelike vibrations in the ether produced by the powerful vacuum tubes in the transmitting station. Sound is impressed on this flow of vibrations by means of the microphone and the apparatus connected to it. What you hear is the result of the translation of the electrical vibrations in the ether into sound vibrations in the air. The function of your receiving set is to accomplish this result.

Static blends with the radio wave like two glasses of water poured into the same pitcher, and you hear the resulting mixture

Why is radio poor in summer?

STATIC is more prevalent in summer than in winter, so that even when conditions are good for the reception of distant stations, static spoils the quality of the resulting music or speech. Radio waves in the broadcast band travel much farther at night, probably due to the ionizing effect of sunlight on the upper air during daytime. In summer the days are longer, the sunlight is more intense and the upper atmosphere does not seem to get into good condition for radio reception during the few hours of darkness.



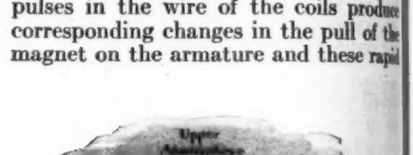
The B-batteries are the power house of your radio set. They supply all the energy needed to make the tubes amplify the weak incoming radio signal and operate your loudspeaker

Is there any difference between radio and wireless?

TECHNICALLY the terms mean the same, but it is customary to speak of transmission of voice or music as radio, while wireless is used to designate the same operation when wireless code is used.

How does the loudspeaker work?

The electrical impulses fed into the loudspeaker by the radio receiver are sent through small coils consisting of thousands of turns of fine wire. These coils are mounted on soft iron pole pieces which are attached to the ends of a powerful permanent magnet. Close to the pole pieces is a small piece of iron called the armature that is connected by a link to the paper of the cone. The electrical impulses in the wire of the coils produce corresponding changes in the pull of the magnet on the armature and these rapid changes in pull are turned into air vibrations by the paper of the cone.



Fading is said to be the result of the interference between two sections of the same wave reaching set from different directions

Where does the energy come from to make the sounds?

The B-battery supplies all the energy. The radio impulse that comes down your antenna, or is picked up by the loop, is used as a trigger to release the power of the battery just as the pull of your finger on the trigger of a rifle releases the tremendous power of the powder charge.

What are wave lengths and kilocycles?

ONE is a measure of length, the other of speed. As the radio waves or vibrations travel along, compressed sections follow areas of lower compression in regular order, just as the peaks of water waves alternate with the hollows in between. The wave length is the actual distance in meters from one peak of compression to the next one. The number of them that pass a given point in a second of time is the measure of the wave length in kilocycles. The shorter the wave length, the more peaks pass during a second. That is why the number of kilocycles increases as the wave length decreases.

Trends *of the* Year in Radio

Survey Shows "Electric" Sets Are Principal Goal of Manufacturers—Other New Developments

By JOHN CARR

THIS year will witness the development of a most remarkable situation in the radio industry.

The average man, interested as he is only in the results to be obtained from radio and unfamiliar with the problems involved in radio reception, has demanded that his set operate directly from the electric light socket without the aid of any batteries or charging devices. On the surface, it seems to be a reasonable demand. Vacuum cleaners, electric toasters, washing machines and any number of household utilities take current from the light socket, so why shouldn't the radio?

Completely electrified radio receiving equipment has been on the market for some time, but only in the high priced class; so this year, when several improvements in existing apparatus and a few radically new inventions made their appearance, the manufacturers determined to satisfy the demand for moderate priced, completely electrified radio receiving sets.

Mountainous difficulties had to be overcome, and some of these still remain to be conquered before full success is assured.

The modern battery-operated radio receiver represents the highest standard of quality so far attained.

No manufacturer of a batteryless set can hope to better a battery-operated set when it comes to actual reception results. However, he may approximately equal such results, and that is what the manufacturers are striving to do this year by the aid of several new devices. In addition, the batteryless set must be reasonable in price, reliable in operation and economical to maintain. The engineering staffs of many radio concerns are hard at work attempting to combine all these qualities in a batteryless receiver. You will see the results of their efforts this autumn in the various radio shows.

Top picture: Back view, showing working parts of new, powerful electro-dynamic loudspeaker. Power unit and B-eliminator built in. Center: Left to right, a combination A, B and C power unit; a combination of storage battery, high rate charger and potential relay, charging of which is automatic; motor generator unit of only receiver on the market that uses this system of supplying A, B and C current. Left: Successor of the old horn speaker

What's New in Battery Sets

SINGLE control or apparent single control and the use of the 171 power tube in the last stage of audio amplification will be almost universal on the new sets this year. By apparent single control is meant receivers with but one main tuning control for coarse tuning and one or more auxiliary knobs that must be turned to get best results on anything except local stations.

Aside from the inclusion of the power tube and better quality audio transformers in all grades of sets, there is nothing new in the circuits employed, so that the new sets are not markedly better than last year's models for either distance or selectivity. The chassis type of construction, in which the working parts of the radio set are built into a rigid unit that slips into the cabinet, is becoming more popular. A great advantage is that it makes it easy for the manufacturer to offer a number of cabinet styles without so much extra expense.

The Electric Models

MANY novel radio receivers operating entirely on the alternating current available at the electric light socket will appear this year. They can be divided into four distinct classes. Each works on a different principle. That fact illustrates the wide divergence of opinion existing among engineers as to the best method of solving the various problems incident to this class of radio receivers.

First there will be a group of receivers in which heater type vacuum tubes will be used. In these tubes the ordinary filament is replaced by a tube that is coated on the outside with a material that will throw off the required stream of electrons when heated, and fitted on the inside with a heating element that is operated by the alternating current after it has been stepped down to about three volts.

A peculiarity of this tube is that it takes a considerable time to get into action, so that you may have to wait as much as a half minute or so after turning on the set before you hear signals. This lagging response makes it difficult to design a suitable means of adjusting the volume. The tubes will cost two or three times as much as the standard types of battery-operated tubes of like capacity, and there is still a question as to how long they will last, although it seems logical to expect that the manufacturers will succeed in making them as durable as the battery tubes.

Another group of receivers will use a new type of tube with a thick filament located to balance the hum as far as possible. These tubes, like the heater types, will be operated by alternating current. However, in this case the current will be applied directly to the filament after it is stepped down to about one to one and a half volts.

As with the heater type tubes, difficulty will be experienced in establishing an adequate volume control, and the problem of eliminating the hum is a shade more serious with this type of alternating current set than with any of the others.

A third class of electrified receivers is what is known as series filament type.

These sets use standard vacuum tubes such as the 199 and 201A. The filaments are connected in series and current is forced through them by an oversized B-eliminator capable of supplying far more current than is required for use in the B-circuit of the set.

The 199 type filament job is, of course, limited in results by the tubes it uses, while the series 201A types are expensive to construct and the replacement costs of the high power rectifier tube that is required may exceed that of batteries. In this case, also, the probabilities are that the manufacturers will improve the tubes up to standard life.

The fourth class of electric receivers is of essentially battery-operated types, except that the battery is replaced by an A-eliminator. There really is a fifth class occupied by just one manufacturer. His new receiver eliminates all batteries by the use of a specially designed motor generator.

Cones Win Out

IN THE battle for supremacy, the cone type loudspeaker has conclusively won. Horn type speakers have virtually disappeared. Much progress has been made in designing new and attractive types that will blend in with the furnishings of almost any kind of room. The shape of the cone has been developed away from the uncompromising circle so that many of the models this year will be oval or of irregular curved shape.

The horn, although now extinct in the form with which we are familiar, is expected to make a comeback in a new cabinet shape somewhat like the long, coiled-up horns that have been developed in the newer types of phonographs.

For extraordinarily high power reproduction another type is making its appearance. This will consist of a cone or one of the special long, folded horns operated by an electrodynamic mechanism. This differs from the ordinary loudspeaker unit in that instead of the conventional horseshoe magnet fitted with pole pieces and coils to act on a small iron armature, the electrodynamic variety will have a large electromagnet and the armature will consist of a tiny coil of wire attached by a link to the center of the cone, or to the diaphragm in the case of the horn types. The advantage of this type of loudspeaker is that the coil can vibrate with greater freedom on extremely loud signals.

Automatic A-Power Units

THE owner of the battery-operated set will not be neglected this year, for there is a bewildering variety of new A-power units designed to get rid of all the troubles commonly complained of with batteries.

You can buy a battery fitted in a case with a trickle charger and an automatic relay to take care of turning the charger on and off as you use the set. These outfits also are provided with a socket into which you can plug the B-eliminator to control it, too, automatically.

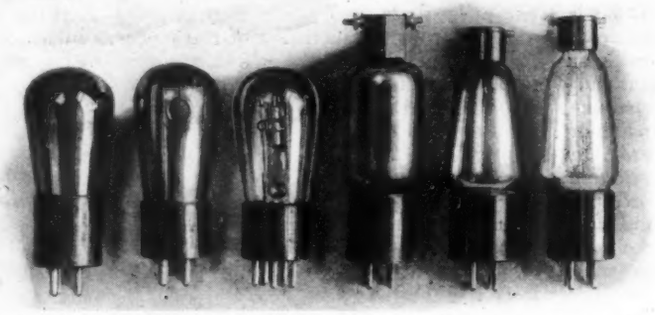
Another model uses a high rate charger instead of one of the trickle type and includes a potential relay which turns the charger on and off depending on the state of charge of the battery.

In every case, the battery itself has been redesigned to provide an exceptionally large water capacity so that watering of the battery need be done only once every six months or a year.

Improved types of chargers are provided for those radio fans who desire to use a separate battery with their sets.

But the A-power buyer is not to be restricted to variations of storage battery and charger. There are several different types of A-battery eleminators to be placed on the market. Several of these operate on essentially the same principle as the modern B-eliminator. There is a transformer, a rectifier and a filter circuit consisting of choke coils and condensers either dry or electrolytic.

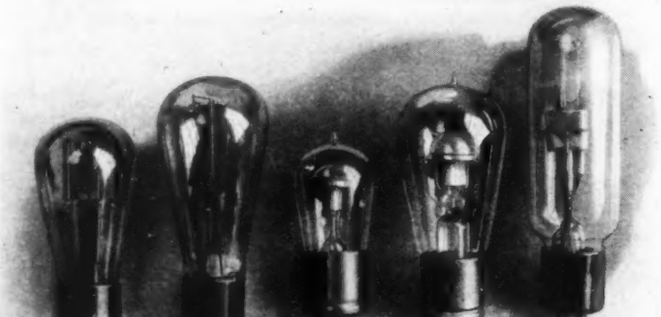
The success of these true A-eliminators will depend on the selling price and on whether they really give good results.



These are the types of vacuum tubes that will be used in the new electrified radio sets. At the left are two tubes for use with alternating current on the filament. The next three tubes are various designs of the heater type filament and at right is a heater type power tube equivalent to the 171 battery type

You May Get Stung!

DON'T buy radio apparatus of any kind unless it has been approved by the POPULAR SCIENCE INSTITUTE OF STANDARDS, 250 Fourth Avenue, New York City. With so much new and untried equipment coming on the market, you can't afford to take a chance. The Institute will gladly answer all letters of inquiry.



Many electric sets will be operated by tubes such as these. The two at the left are full and half wave filament rectifier tubes of a new high current type. In the center is the 85-mil tube that will be used with sets operating 199's in series and the two at right are for use with 201A tubes wired in series

High Voltage B-Eliminators

NO BASIC changes in design will appear in this season's models of B-eliminators. Practically all types will be capable of supplying 180 volts so that you can operate a 171 type power tube to maximum efficiency. There is a tendency to eliminate adjustable controls.

All the Volume You Want

IF YOU have a desire for loud volume from your speaker there will be plenty of equipment offered to satisfy your needs. Several models of power amplifiers already are on the market and others are to follow. These units can be hooked between any set and the loudspeaker. Essentially they consist of a B-eliminator developing 400 volts or more, and they include the necessary parts so that you enjoy the volume produced by the powerful 210 type tube instead of the last tube in your set which, in most cases, is taken out of the receiver and an attachment plug put in the socket in place of it. In every case these power units also supply the necessary B-current to operate your set so that you eliminate the B-batteries and at the same time improve the power and tone quality, all with the one unit.

How to Choose Your Set

IF YOU have been a radio fan for some time, you will welcome the many developments in radio this year. No matter what your ideas may be as to what constitutes the ideal radio installation, you will be able to buy standard equipment to suit you. In fact, there never has been a time in the radio business when such a wide variety of equipment has been available.

On the other hand, if you are a new radio enthusiast, and have never owned a radio receiver, you are facing a puzzling problem. However, if you will keep certain facts constantly before you, the whole question will become much clearer.

First remember that tone quality is the most important feature in the performance of any radio receiving set. Don't buy any set unless you are perfectly satisfied on this point.

Second, in choosing between a batteryless and a battery-operated set, remember that for clear tone, volume, selectivity and distance the battery-operated set is as nearly perfect as is possible in the present stage of the radio art. A batteryless set may closely approach such results—closely enough, in fact, to suit the most critical ear. Choose between them, therefore, on the basis of first cost, cost of upkeep and amount of attention required.

Pointers for Radio Novices

Condensers *and* Cabled Leads

How to Get Purer Music and Clearer Speech

THE ease with which alternating current passes through a fixed or variable condenser depends entirely on the frequency of the alternation. At the tremendously rapid alternations of radio-frequency current, a very low capacity condenser offers but little resistance to the current flow. At audible frequencies—those which can be heard—the condenser must be much larger to pass the same amount of current at the same voltage or pressure. And when you slow the oscillations of the current down until they stop and the current flows steadily in one direction instead of alternating back and forth, a condenser, no matter how large, will completely stop the flow of current.

These facts govern the results you will obtain when you connect a condenser in a circuit carrying electric current, such as the circuits in your radio set. If, for example, you have a circuit in which current is flowing at two distinct rates of alternation, a condenser can be used to separate them. A small condenser cut into the wiring at any point will allow practically all the high frequency current to continue flowing, while it will act as a gate to stop the lower frequency. However, the separation will not be absolutely complete, for some of the lower frequency current will get through.

A SHUNT arrangement of the condenser will have the opposite effect. It will allow the high frequency current to flow through the shunt circuit, while the lower frequency will continue on the original wire.

Remember that the effect is never complete, and so when you try to by-pass the radio-frequency current in a circuit, you also by-pass a small amount of the current that is flowing at audible frequencies. This would be of no importance except for the fact that more of the high audible frequencies that go to make up the high notes are removed from the total flow of current than of the lower frequencies that form the bass notes, and distortion of the musical notes is introduced.

You can test the working effect of fixed condensers very simply. Take a .01 fixed condenser and connect it across the terinmals of your loudspeaker. You will notice the tone takes on a deep, throaty quality, and speech, which depends for its clearness on the higher audible frequencies, is hard to understand. What is happening is that the higher audible frequencies are going through the condenser instead of through the loudspeaker. Now try connecting the condenser in series with your loudspeaker. The tone will immediately become thin and tinny for music, or high pitched and nasal for speech, indicating that the lower audible tones are not going through the condenser nearly so well as those of high pitch.

This tiny fixed condenser is connected in a new way. A wire is first run between the two points in the set to which the condenser is to be connected. Then the condenser lugs are soldered to the wire at any convenient point, after which the wire between the two lugs is cut away

A B C's of Radio

IT IS quite possible to rebuild your old radio set with modern audio transformers with the object of improving the tone quality and then find, when the job is finished, that results are not up to expectations. If this happens to you, don't blame the transformers until you have satisfied yourself that some other factor is not responsible for the poor tone.

Frequently the trouble is due to a poor arrangement of the instruments. Electrical efficiency is sacrificed to obtain neatness. The golden rule in constructing an audio amplifier is to keep grid and plate leads as short as possible and to keep them away from each other. As an added refinement that is worth while in many cases, connect ½ mfd. fixed condensers between the plus B and the F terminals of each transformer and the nearest point on the filament circuit and ground the frames of both transformers.

This convenient cable and plug attachment gets rid of seven binding posts and an equal number of loose, dangling wires when connecting up your radio receiving set to the batteries

Advantages of Cabled Leads

MANY factory-built radio receivers are now constructed without binding posts. Instead, there is a heavy cable brought out of the back of the receiver. This cable contains in one woven covering all the wires needed to connect the power supply to the radio set. Sometimes the ground connection is included, but the antenna connection is separate, because, while introducing capacity between the battery leads helps to get rid of stray coupling effects, including the antenna lead in the cable would result in a definite falling off in signal strength. The weak radio-frequency current in the antenna lead would have a tendency to travel to the ground by way of the capacity to the other wires rather than to follow the correct path through your radio receiver.

ASIDE from the neatness of the cabled battery leads, the manufacturers find, in most cases, that this method of construction reduces manufacturing cost.

If you are building a new radio set or re-vamping an old one, you can take advantage of the cabled battery lead construction by using one of the units now sold for this purpose. It will save you the trouble of constructing a binding post panel and will make it a simple matter to disconnect all the battery leads without chance of short circuits, merely by pulling out the plug shown in the illustration at the bottom of this page.

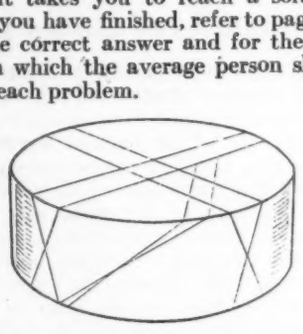
The section containing the connecting pins shown at the right in the illustration should be fastened to the baseboard near the back of the cabinet. A round hole slightly larger than the plug should be bored in the back of the cabinet in line with the piece mounted on the baseboard. Supply wires to various parts of the radio receiver are soldered to the projecting lugs on the back of the device, and the separated wires at the end of the five-foot cable are secured to the correct binding posts of the A-battery, B-batteries or B-eliminator and C-batteries.

Puzzling with Sam Loyd

Sharpen Your Wits on These

Six Tests for Straight and Fast Thinking

THESE brain teasers by Sam Loyd, most famous puzzle maker in the world, are presented from month to month by POPULAR SCIENCE MONTHLY in response to requests from hundreds of readers. They are not mere time killers, but real tests of your mental ability. In tackling each of the problems, make a note of the time it takes you to reach a solution. After you have finished, refer to page 161 for the correct answer and for the time within which the average person should solve each problem.



Cheese and Imagination

THE sketch is of a big cheese that has been dissected by six straight cuts of a knife. It requires considerable imagination to see into the middle of the cheese and count all the big and little pieces into which it has been divided by the six cuts.

At the present price of the commodity we will not suggest that readers experiment with the real article. Just concentrate upon the sketch and build up an imaginary total of the pieces, seen and unseen. How many pieces can you count in your mind's eye? Time your answer, then turn to page 161 and see how well your imagination has functioned. There also you will find the correct answer, giving the number of pieces made by each cut.

Guess This Word

THERE is a little word which signifies an affirmative. With another letter prefixed it becomes a negative. With other one-letter prefixes it might be successively changed to something lively, a bird, a fish, a body of water, a period of time, a little fairy, a month, fodder, a song, money, a direction, or a talkative word.

Trace this little word to its lair, and put it through its transformations. You'll be surprised at the opportunities offered by language for exercises of the mind—opportunities which have made some people devote their lives to the study of words. After you have done your best, refer to page 161 for the correct answer, as well as the time it should have taken to answer the problem, if you possess a good vocabulary.

An Arabian Lunch

WHILE traveling in Arabia, I sat down one day to lunch at a roadside tent with two natives, who provided a frugal repast of bread. One man contributed five loaves and the other three, and I accepted their invitation on condition that I be permitted to pay for my portion.

We three consumed equal shares of the eight loaves, and upon taking my leave I laid down eight pieces of silver to pay for my share. The contributor of the five loaves appropriated five pieces of the silver and left three to his partner, who objected to the division and insisted on his getting half of the money.

I refused to adjudicate the matter offhand, but figured it out as I continued my journey. How do you figure they should have equitably divided the eight coins? See how long it takes to answer, then turn to page 161 for the measure of your reasoning power.

An After-Dinner Test

HERE is a little after-dinner diversion. The proposition is to take up two adjacent glasses between finger and thumb and set them down together in another location on the line. Three such moves, if correctly made, will re-form that line of touching glasses so that the three filled ones will be together, and the three empty ones together.

Figure out those three shifts as quickly as possible. See page 161 for the solution and a measure of your ability to take mental short cuts.

The Cost of a Villa

THE Smiths were purchasing a suburban villa when Smith remarked to his wife: "If you give me three fourths of your money I can just take the $6000 house and you will have enough left to buy the shady grove and running stream."

"No, no," replied his better half. "Give me only two-thirds of your money and I will buy the house, and you will have enough over to purchase the grove with the babbling brook."

From this domestic colloquy we are expected to figure out the value of that shady grove, with its never-failing stream. It is an exercise in mental arithmetic that will prove how quick you are at figures.

After reaching your answer, note the time required, then on page 161 see the correct answer and the time it should have taken.

A Present for Grandma

THE little miss at the left wants us to show her how to cut her piece of cloth into four parts of the same form and size so that she can group them together to make a perfectly square shawl for grandma.

One who can convert that remnant into a square in a limited time will demonstrate possession of a keen sense of form and ability to reason analytically.

Many a person who is more than willing to oblige the little girl will find it is easier said than done. Try; then turn to page 161 and see if you have succeeded within the time limit.

Sam Loyd has prepared another set of his fascinating new puzzles to appear in next month's issue

Is Your House Burglar-Proof?

Precautions You Can Take to Guard Doors and Windows and Double Security of Your Home

By JOHN R. McMAHON

Bad house construction for the occupants; but good for the burglar, for whom a cornice or a porch so located makes a window accessible

JIM the truckman used to drive his two-horse open vehicle to the back door of the bank. Men came out with small heavy boxes and threw them onto the truck. It did not take many boxes to make a ton of gold, worth half a million dollars. A tarpaulin was tossed over the load as a graceful gesture of protection. Jim yawned, lighted his cob pipe, made room on his seat for a single guard whose protective ability was about equal to that of the tarpaulin, and

A short chain attached to door jamb and hooked on door excludes the would-be intruder to whom the door has been unlatched

"giddapped" his horses. The truck lumbered with its gold cargo through miles of city streets, unnoticed and unmolested.

That was just a couple of decades ago. Today a car like an army tank with peephole turrets and bullet-proof glass and a crew of sharpshooters with rifles and machine guns goes to the bank for a load of gold. The guards deploy in the street like advance scouts of an army in touch with the foe. And despite such measures of security, the enemy quite often makes a successful raid on the treasure.

Does it mean anything to the householder that robbery has vastly increased in the United States? I believe it does, apart from the general interest all citizens should have in the matter. The crime increase is not limited to deeds of sensational violence. There is also more house burglary, porch climbing and sneak thieving. We may expect yet more as we become more civilized, crowded and wealthy, and it is worth while to consider what may be done about it. A couple of generations ago there was practically no residence burglary insurance. Today this department is half the business of a large company and amounts to several million dollars.

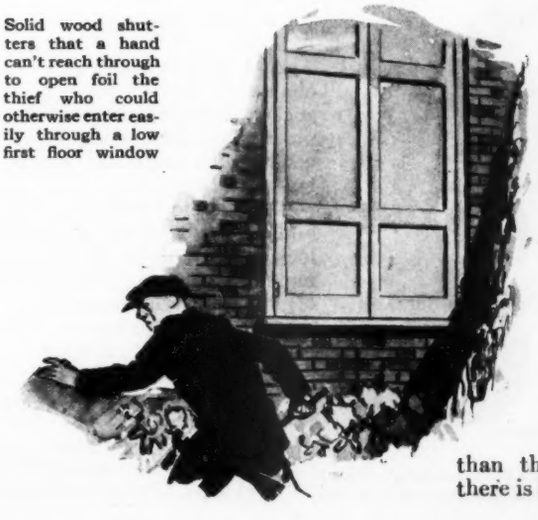
American houses outside of cities used to be commonly left unlocked, day and night. If locked by the timid against the occasional tramp, the key was under the mat. The principal intruders to guard against were cats, children and book agents.

EXCEPT for a low hedge or a row of pickets there was no separation of the house from the street. Today an increasing number of dwellings are encircled with woven wire fencing attached to metal posts set in concrete, sometimes topped with two or three strands of barbed wire.

"Why should I become excited over the burglar menace and spend a lot of money on precautions that may never be needed?" you may object. "There is little to steal in our house anyway—a few silver spoons, a couple of rugs, some jewelry trinkets and a trifle of cash. All this would not tempt a real burglar and if stolen would not ruin us."

It is quite right to view the matter thus calmly and to refrain from extreme and costly measures of protection. On the other hand it is well to be reasonably prudent in the employment of safeguards. No one likes to lose even objects whose value is mainly sentimental. A feeling of security is worth something, especially to the timid members of a household. When the head of the family is away, he likes to think his home is reasonably safe from intrusion. When everyone leaves on a summer vacation, it is comforting to reflect that the house is not likely to be raided.

Architects plan houses to be proof against wind pressure, fire, heat and cold. They should now include burglar-proofing within the limits of practicality. This has indeed been done to some extent. It is logical, easier and cheaper to embody safeguards in the architecture of a dwelling than to add them afterwards. Basic principles can be applied and most of them have a general merit in good construction besides serving to balk the felonious visitor.



Solid wood shutters that a hand can't reach through to open foil the thief who could otherwise enter easily through a low first floor window

Windows are generally most vulnerable because of their location near the ground and other reasons. The higher window sills are above grade the better. This means high foundations and living quarters that are high, dry and light. The proper height of a window sill above grade cannot be precisely stated. Five feet is good, more is desirable. Never mind the argument that the thief can use a ladder. He avoids using a ladder when there are convenient low windows next door. It may be remarked that it is not usually feasible to obtain height of window sill on the inside; with more than thirty inches from floor to sill there is loss of light and ventilation.

Low windows as in a cellar may be protected with a metal grille or with iron bars. In a new building half or three-quarter-inch bars may be placed through holes bored in window frames before the latter are set in concrete or masonry. Bars should be about six inches apart. I have found by experience that a good sized person can get through a space eleven by fourteen inches. By placing bars within window frames there is no interference with screens outside or sash inside. Next to grille and bars in protective value is a window of wire glass, which repels fire and also the intruder who would cut or smash an easy entrance. Metal coal chute windows also safeguard against fire and intrusion.

AGAIN, there are several advantages in the use of plate glass. It gives clearer vision and resists wind pressure as well as the malefactor. Whatever the glass, a sash divided into small panes is usually safer against elemental or human attack.

The lateral spacing of windows may be an important feature of protection and costs nothing when building. This refers to the distance between window sill and a point of too convenient access, whether porch or roof. Often a window is but a step from a porch or just around the corner of the wall. Place that window two or three feet farther away and your home will be more secure.

Inventors have been busy devising secure fasteners for windows of various types—casement, center-hung and side weighted. The latter type has been equipped with a protective metal grille which, when the lower sash is closed, is invisibly housed in a slot beneath. The grille rises with the lifted sash; likewise, if desired, a fly screen of bronze or copper wire. Grille and screen may be detached from sash for daytime use, or for cleaning glass, and either or both may be connected for night operation. It would be comparatively simple to have another section of grille operated from above or below.

THERE is less expense and unlimited application in outside window shutters of solid wood type. This present-day architectural revival looks well and protects against high winds as well as malefactors. There are ornamental openings through the shutters for ventilation when closed.

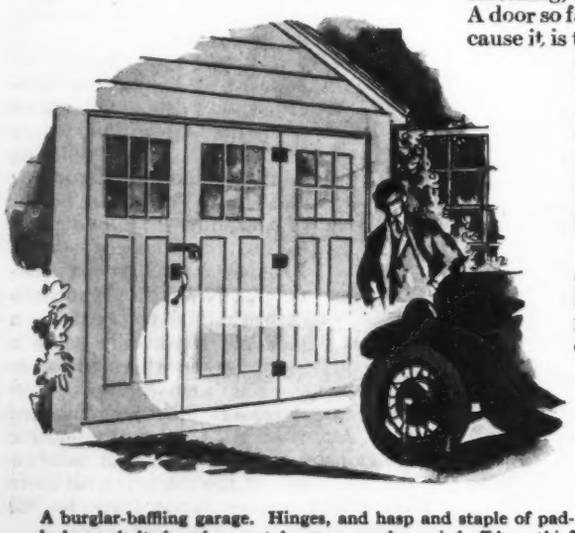
It is well to multiply interior obstacles and to pay special attention to the fastenings of vulnerable windows and doors, as those giving on a porch or leading to cellar. The average house, once entered, is easily traversed, but it is simple to convert it into a series of compartments, which are most discouraging to the uninvited caller. Let him stew awhile in the difficult-to-emerge-from cellar and then spend plenty of time on the first floor trying to obtain access to the floor above. Meanwhile the occupants will be roused and call the police.

Outside doors are often flimsy and vulnerable in several ways. The glass section of a front or porch door makes it no better than a window, unless the glass is small or is backed by a grille. There may be a stout hardwood door in front and a thin panel door at the rear entrance. The latter is too easily bored with a bit and brace, and sawed with a keyhole saw. It gives with the slight leverage of cold chisel, tire tool, small wrecking bar or jimmy. If the lock does not yield, trifling hinges will. Every outside door should be substantial and should have three pairs of hinges — termed butts in the building trade.

If holes are bored at intervals in window sashes heavy nails or rods can be inserted where the holes meet. This simple expedient locks the windows closed or partly open as you wish

Instead of one lock there should be three, or the equivalent with top and bottom interior bolts added to the key lock. If the marauder saws out or breaks one fastening, he has two more to cope with. A door so fastened excludes cold drafts because it is tight in its frame. Most doors warp out of shape and do not fit tight with a single fastening. Also it is well to have door chains. Anyone may improvise such a fastening with a short piece of any kind of chain plus a hammock hook and a bolt, lag screw or staple.

The hostile attack by saw and bit upon locks and padlock hasps may be checkmated rather easily in the case of garage and other doors where interior appearance does not matter. Fasten an iron plate with screws through drilled holes on the inside of door. The plate should be considerably larger than area of lock or hasp. If there is no suitable plate at hand or there is difficulty in fitting, screw in place a series of mending plates or flat angle irons. When the intruder's implements strike metal he will feel inclined to give up his undertaking.



A burglar-baffling garage. Hinges, and hasp and staple of padlock, are bolted and cannot be unscrewed or pried off by a thief

Bars secured to the bottom of this window sink into the wall when it is closed, and when a burglar opens it they rise to dismay him

Padlock hasps should be of the type where heads of wood screws are covered against easy removal. Otherwise use bolts with nuts turned fast on the inside. The weakness of every padlock is in its U-shaped hinged bolt which may be speedily cut through with file or hack saw. An expensive brass padlock, incidentally with an unpickable lock, is easier to cut in this manner than a cheap iron padlock. There are two ways to fortify this weakness, first by locating the fixture so that it is difficult to reach with saw or file; second, by fitting small bits of pipe as loose collars over the exposed parts of the U-bolt. The collars revolve when attempt is made to use a file or hack saw.

THE common door lock with large key and keyhole responds readily to a skeleton key and even yields to a bent wire. A lock which cannot be picked or opened with a false key, which is substantial, nonrusting and durable, is known as a cylinder lock. It has a thin key with saw grooves along one side. This key and lock are used for safe deposit boxes, automobiles, hotel rooms and outside doors of apartments and residences. The better sort of padlocks belong to this type. A cylinder lock is mortised into a door with the outside keyway either separate or, more conveniently, at the head of the knob. There is usually a spring bolt and a dead bolt, one above the other. The spring bolt, if solely depended on, cancels the value of the best of cylinder locks. It is easily pushed back by any sharp flat tool driven between door and casing. On the other hand, the dead bolt can be moved only with the proper key. Apply the dead bolt at night and use it for outside locking when leaving the house.

It is convenient to have uniform cylinder locks for house and garage so that all will open with one key or at least with a master key held by the owner. There may be partial master keys to open two or three locks as well as one that operates all. An extra sub- (*Continued on page 17*)

Don't Be a Back-Seat Driver!

Gus Helps a Husband Who Was Nagged into a Smash and Gives Some Advice for Passengers

By MARTIN BUNN

"Lay off me!" he snarled. "How the dickens can I drive with you jawing all the time? If you know so much about it you can drive yourself from now on. I'm through!"

"NOW Horace," nagged the cross looking woman in the back seat, "are you sure we don't need oil? You'd better have the man look over that back tire while we're here. Is the radiator full of water? Remember what I told you—"

"Yes, my dear," the solemn faced man behind the wheel mumbled mechanically as he received his change from Joe Clark, threw the ignition switch and kicked the starter button. Meanwhile the flow of advice and commands from the woman on the back seat continued.

"Be careful not to grind the gears, Horace! Don't let in the clutch too fast, you jarred me terribly the last time—look out! There's a car coming! You'll hit it sure as I'm alive—"

"Yes, my dear," floated back to the garageman's ears as the car rolled away.

"How'd you like to be tied to that for the rest of your life?" grinned Joe Clark to his partner Gus Wilson, who was working on a car in front of the Model Garage.

"HUMPH!" grunted the veteran auto mechanic. "Every time I hear a nagging woman like that I'm glad I'm a bachelor. She's a 'back-seat driver' for—"

"Look! Quick!" Joe interrupted with a shout. "Whatever is that bird trying to do! He's heading straight for that parked car. If he doesn't head out pretty soon—by Jinks, he woke up just in time—and now look at him skid! That's no trick to be playing on a wet road—twice around and going straight at the telegraph pole!"

But the car's speed slackened considerably before it hit the pole and luckily for the occupants, it was traveling backwards at the moment so the impact came directly on the center of the rear bumper. The latter cushioned the blow to some extent, but Gus and Joe distinctly heard the snap as the spring steel gave way.

Even before Gus and Joe could reach the scene of the accident, it was quite evident no one was seriously injured for they could hear the woman rasping on interminably.

"Now, see what you've done, Horace! Why didn't you pay more attention? I never saw anyone so careless! The whole trip is ruined, and it's all your fault!"

The car owner had been aimlessly puttering around, muttering "Yes, my dear," but this last remark suddenly got his goat.

"Yes, my—Aw, rats!" he snarled savagely. "Lay off me! How the dickens can I drive a car with you jawing all the time? If you know so much about it, you can do it yourself, from now on. I'm through!" And with that he dashed a wrench on the ground, glared at his wife defiantly, spun on his heel and stalked off down the road.

"Here's where I cure one back-seat driver of a mighty bad habit," whispered Gus to his partner.

"Most unfortunate accident, madam," he said, stepping up to the side of the car. "Can we help you out?"

"You're the men from that garage we stopped at," the woman said. "Well it's a good thing that fool husband of mine had sense enough to have this accident where it could be fixed. He doesn't pay any attention to what I say—just goes along and drives to suit himself. I'll give him a piece of my mind all right!"

"Can you drive the car to the garage?" asked Gus after he and Joe had freed the spring that had caught around the pole.

"I don't know how to drive," she snapped.

"Oh," said Gus, with an odd smile. "Then I'll drive for you. I can make a temporary repair on the bumper, and there isn't much else to fix."

Horace had marched down the road and perched on a stone wall where he was calmly smoking a cigarette.

"Don't bother with him!" rasped his wife. "He can stay there forever for all I care! Drive to the garage."

As soon as Gus had stopped the car in the garage, he and Joe set to work.

"What's the matter with the car, anyway?" the woman inquired.

"Well, madam," replied Gus, "this car has a broken rear bumper. The gas tank is dented, a mud guard is bent out of line. That's what's wrong. But as for what caused it, I'd say it was—you!"

"Me!" she gasped indignantly. "Ridiculous! How could I be to blame when I wasn't even driving the car?"

"Maybe you didn't actually have your hand on the wheel," Gus growled, "but from what I heard while you were getting gas you do all your driving from the back seat. No man can drive a car and do a good job of it with somebody pouring advice into his ear all the time. You probably kept telling your husband how to drive until he got so flustered he didn't know what he was doing. Take it from me, if you want to avoid trouble let your husband drive in peace. You admit you don't know how to drive so your advice couldn't be worth much anyway!"

"THERE!" interrupted Horace, who had silently entered in time to hear most of Gus's remarks. "That's just what I've been telling you all the time, and you wouldn't listen to me! Now you get exactly the same thing from somebody that really knows something about automobiles!"

Horace settled with Gus, climbed into the car and stepped on the starter. His wife started to speak and then gulped back the words with a quick look at Gus.

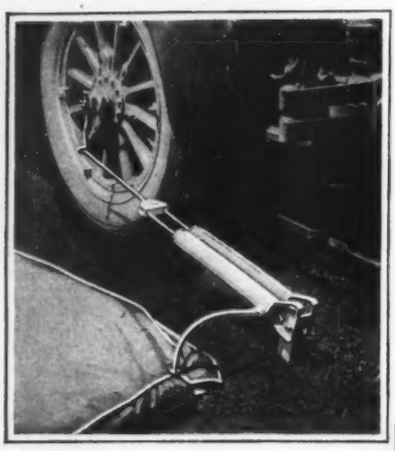
"By Golly!" exclaimed Joe. "It almost looks as though you'd shut her up."

"Maybe," replied Gus, "but I doubt it. Takes a lot more than that to cure a woman who's in the habit of bossing her husband.

"A lot of people don't seem to realize that driving a (*Continued on page 182*)

Ideas *You Can* Use on *Your* Car

How to Double the Life of Tire Chains—A Wheel-Driven Pump for Campers—Other Ingenious Kinks



Ten Dollars for an Idea!

F. R. GORTON, of Ypsilanti, Mich., wins the $10 prize this month for his suggestion of an air mattress inflating method (Fig. 1). Each month POPULAR SCIENCE MONTHLY awards $10, in addition to regular space rates, to the reader sending in the best idea for motorists. Other published contributions will be paid for at the usual rates.

Engine Pumps Air Mattress

AFTER a day on the road the motor camper usually does not feel in the mood for the job of pumping up the air mattresses. By using two of the regular pumps supplied with the mattresses, arranged as shown above, you can make the auto engine do the work for you. The two pumps are fastened together and held by a hinge to a hardwood stake to be driven into the ground back of the rear wheel. The hub cap is prepared with two driving pins and a threaded stud. The rear wheel is jacked up and then the stake is driven at the correct distance. The length of the crank should be slightly less than half the total movement of the pump handle. The wheel should be run by the motor in low gear. Test the location of the stake by turning the wheel by hand. This is important, for if the stake is not located the proper distance behind the rear axle, the pump may be smashed. Of course the idea of using two pumps is to permit pumping up two mattresses at the same time.

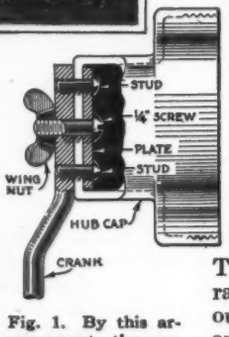


Fig. 1. By this arrangement the engine is used to pump up the air mattress

Windshield Wiper Holder

THE mechanism of your windshield wiper wears in after it has been in use for some months and then you will experience some bother because the jarring of the car will gradually move it down into your line of vision. To save yourself the annoyance of constantly pushing it up out of the way, add a spring clip as shown in Fig. 3. Then when you wish to use the wiper on rainy days, the end of the spring is slipped out from underneath the arm and it snaps away from the path of the wiper arm. If your wiper is different from that illustrated, change the shape of the spring to clamp under any convenient screw.

Emergency Valve Grinder

FIG. 2 shows a simple method of making a valve grinding tool that will do good work with minimum effort by the operator. A section of broomstick or an old shade roller is cut to the right length, slotted at the bottom and drilled for a cotter pin. The grinding blade can be filed out of a piece of scrap iron with two projections that will fit in the holes in your valves. Hold the bow at a slight angle so the rope will not chafe. More speed is had by a spring underneath that lifts it when the handle is raised.

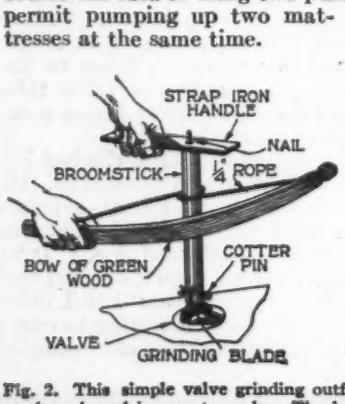


Fig. 2. This simple valve grinding outfit will do good work and is easy to make. The bow should have just enough tension to keep the rope taut

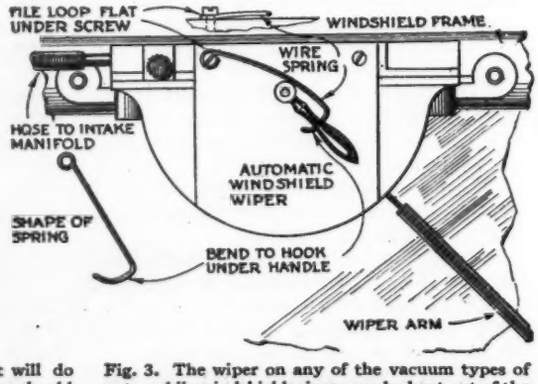
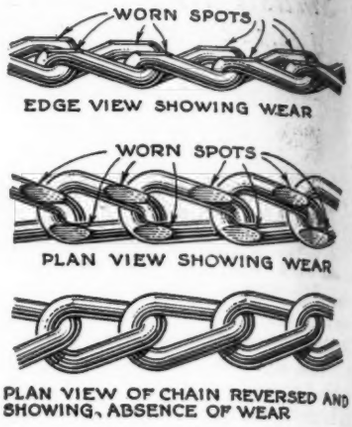


Fig. 3. The wiper on any of the vacuum types of automobile windshield wipers can be kept out of the way with a piece of spring wire bent as shown


WORN SPOTS
EDGE VIEW SHOWING WEAR
WORN SPOTS
PLAN VIEW SHOWING WEAR
PLAN VIEW OF CHAIN REVERSED AND SHOWING ABSENCE OF WEAR

Chains Last Twice as Long

IF YOU will examine your tire chains you will find that the wear comes at the points indicated in the drawings above and, owing to the curve of each link, when you turn the chain over, the wear comes at a different point on the link. The worn spots will not harm the tire. As the life of a cross chain is terminated when the link wears all the way through, you can get practically twice as much wear out of a pair by reversing them every time you put them on. Make sure that the chains are fitted loose enough so that they creep around and around on the tire.

Simple Holder for Hats

EVEN in cool weather there are times when the occupants of a closed car desire to go without hats. This is particularly true during stormy weather when it is necessary to keep all windows closed. A simple holder that will keep any type of hat out of the way is shown in Fig. 4. A strip cut from an old inner tube is fastened to the top after a long slit has been cut down the center. There should be just enough tension to hold the hat in place without crushing. If desired, the hat holder can be stretched crosswise instead of lengthwise and two or more strips used instead of one, or it can be located on a side panel instead of the top.

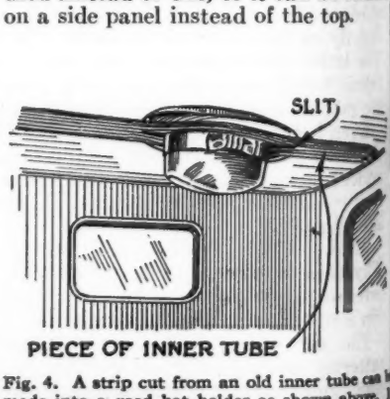


Fig. 4. A strip cut from an old inner tube can be made into a good hat holder as shown above. It will hold any type of hat without crushing

★ Stop a moment and think—Lindbergh's amazing flight, the situation in Italy, prohibition, electric refrigeration, television, electricity in medicine and surgery, new statistics in all branches of commerce and trade, oil burners, the Mississippi flood, the last sixty years in Canada, the last ten years in Europe—these—and hundreds of other things that have happened within the last six months, are what intelligent people want to know about. Fast bound encyclopaedias *Are Always Out of Date.*

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Now-Electric without acids, liquids

Absolutely dry, trouble-proof

NOW, real electric radio power is an accomplished fact. Radio power as permanent and dependable as your house current, without acids, liquids or charging bulbs . . . without the watering and the bother that heretofore was necessary with radio socket powers.

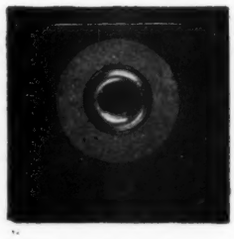
A Revolutionary Achievement

KUPROX . . . the new dry metallic disc rectifier . . . has actually revolutionized radio socket power. It has given to radio a source of real electric power that gives you all the current you want for as many hours as you want . . . radio power that turns on and off with the radio receiver, . . . that requires absolutely no attention of any kind.

Now to turn on the set is to have a flood of power always ready . . the snap of your set switch sends A, B, and C power seething through your receiver, operating always at the same high peak of efficiency, never running down, never a moments worry, never a lost program.

Absolutely Dry All-Metal

KUPROX RADIO POWER DEVICES are absolutely dry. They are all-metal. They use no liquids of any kind . . no acids . . . no charging bulbs. Simply install KUPROX Devices on your set and forget them . . . . no watching, no watering, no attention of any kind. They operate only while the set is operating . . when you turn off the set the current stops.



This is KUPROX the marvelous new metal. A series of these metal KUPROX discs makes radio power of ordinary house current. All-metal, dry, nothing to wear out or replace.

THE KODEL RADIO CORPORATION

K U P

DRY RADIO P

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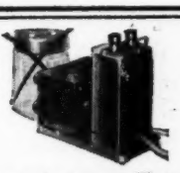
Radio Power- or charging bulbs - -

No watering or other attention!

KUPROX is the development of scientists that has startled radio engineers. This new discovery has converted an ordinary metal into a heretofore unheard-of, un-thought-of source of radio power. It has obsoleted old methods of rectification . . it has brought the radio fan absolute freedom from care and worry. Now radio power is not even as much trouble as the tuning of your receiver. Radio power has been simplified until it is as trouble-proof as any electric appliance in your home.

Relief From Trickle Charger Troubles

For present owners of wet electrolytic trickle chargers and power units, Kuprox offers immediate relief from watering and charging troubles. The KUPROX Replacement unit eliminates the acid jar and makes any electrolytic charger absolutely dry and trouble-proof.



Convert your Trickle Charger into a dry unit

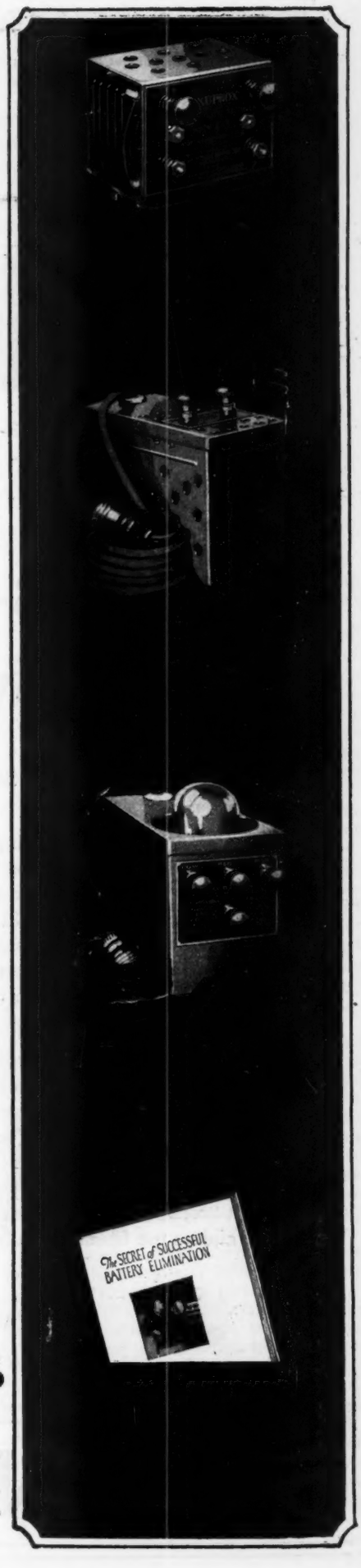
Eliminates watering and all other attention. Simply disconnect the acid jar and throw it away. Replace with the KUPROX Unit. Two simple binding post connections. Price $4.50

Many Models To Choose From

A complete line of KUPROX Radio Power Devices is now sold by your radio dealer. Many models are offered, from the efficient 1-ampere Trickle Charger, to the high powered Combination A & B Models which supply all radio power for your receiver from a single compact unit.

See KUPROX Radio Power Devices at your dealer's. He can tell you more of their remarkable performance. Or, if your dealer does not yet sell KUPROX, write direct to us for a complete booklet on these remarkable radio devices.

500 E. Pearl St. Cincinnati, O.



PROX

POWER DEVICES

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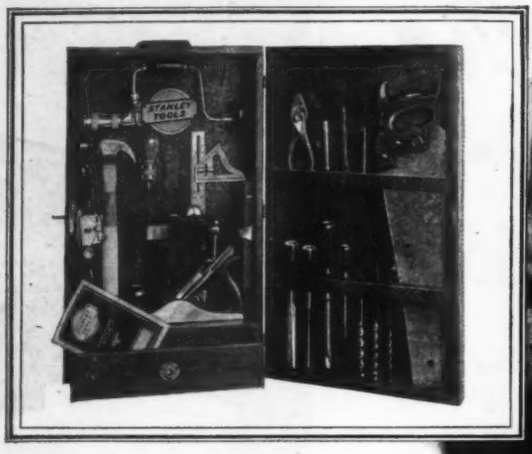
Buy separately or in assortments



She sews— but how?

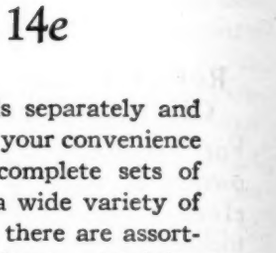
Make a sewing cabinet from Plan No. 14*e*

In comfort with everything in order—or in discomfort with everything scattered? What a tool chest is to a tool user, a sewing cabinet is to one who sews. She would appreciate a sewing cabinet like the one shown above. *You can make it.* Stanley Plan No. 14*e* gives all details. How is that for a Christmas suggestion?

Of course you realize that to do good work you need good tools. The amateur needs good tools even more than the professional. Most carpenters use Stanley Tools because they know from long experience that the Stanley name promises durability, correct design, and right "feel." And thousands of manual training classes use Stanley Tools.

You can buy Stanley Tools separately and so collect your own set. For your convenience in buying there are also complete sets of Stanley Tools in chests at a wide variety of prices from $15 to $95. Or there are assortments in strong cardboard boxes containing directions for making your own tool chest. Priced from $5 to $20.

Your hardware dealer has Plan No. 14e as well as other Stanley Plans for making useful articles, or he can get them for you. The plans cost only 10c each. Ask him also for small Catalog No. Se50—which shows many useful Stanley Tools. It is free. If he cannot supply you write to The Stanley Works, New Britain, Conn.



The best tools are the cheapest to use
Ask your hardware dealer

STANLEY TOOLS

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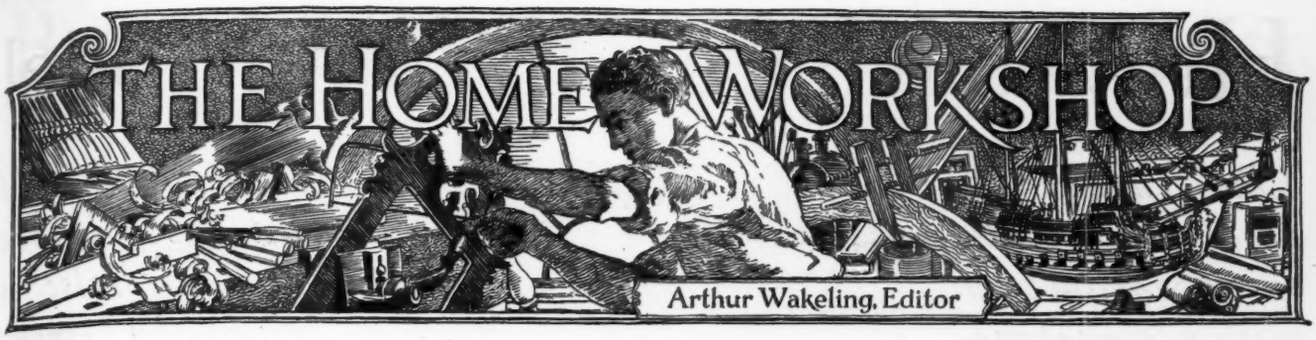


Patching Damaged Furniture

How to Play Surgeon to the Woodwork in Your Home— Fillers for Cracks and Holes — Polishing Blemishes

By CHELSEA FRASER

BUMP! If you have a youngster in your home, you know that kind of sound only too well. It means that Bobby, in the next room with his toy car, has violated the traffic code of the household, as laid down by yourself, and has had a tremendous collision with some piece of furniture. Even more than *that*, it means there's a new scratch or dent—not in Bobby or his car—to be fixed up.

Who's going to do the fixing? If you're like many home owners, it won't be you; you feel that you'd only make a mess of the job. So, at no little expense, you engage a furniture repairman. Had you known what a simple matter it would be to fix the damage yourself, I am sure you would have frowned less heavily at Bobby and gone straight to work to remedy matters.

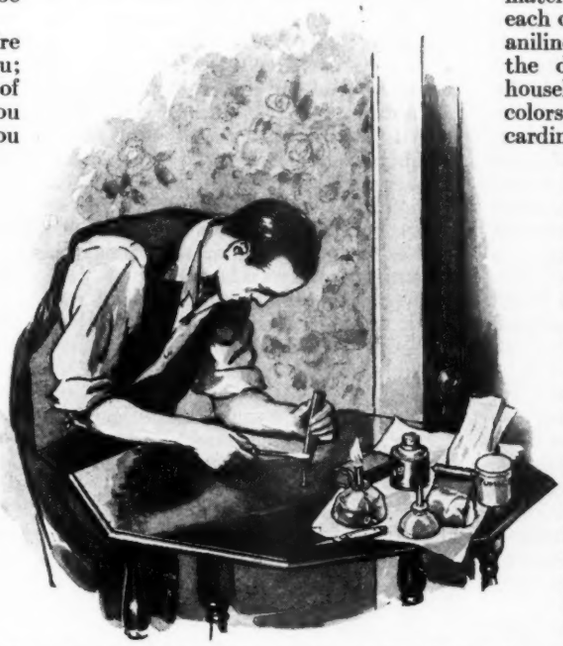
Few realize that when a beautiful, new, spic-and-span article of furniture comes into the house the chances are two to one it has been "touched up" (treated for scratches, bruises and other defects) before it left the store.

THE fact is, every furniture factory employs a touch-up man—some of the larger factories, a squad of them—and these fellows are kept busy inspecting outgoing shipments and repairing surface blemishes of many kinds, which are acquired in moving the furniture through the factory from stainers to fillers, fillers to coaters, coaters to trimmers, and trimmers to packers.

And then comes the other end of the adventure—the trip to the retailer. By the time the crates pass through the loaders, jog over many miles of steel rails or concrete roads, are handled by the unloaders, given a truck ride through busy streets, unloaded by truckers, and unpacked by packers in the retail store, there may be fresh blemishes. So the retailer has his own touch-up men, and the science of wood surgery is once more called into play to hide the scars.

In spite of the fact that your new piece of furniture may reach you after undergoing as many as two or three operations, the work of these craftsmen is, as a rule, so cunningly done that you are unlikely to detect the repair.

All this points to but one conclusion: that if you want to stand guardian over the welfare of your household furniture, you must adopt practical methods of fixing up the blemishes which will occur from time to time.



How a dent or crack is filled by melting a shellac stick into it, just as sealing wax is applied. Only a few inexpensive materials are needed for touching up all ordinary types of furniture scars

You may be surprised to learn that nearly every tool you are likely to need for touching up your furniture can be found in the ordinary home. As a burning iron, nothing can surpass a common, medium-sized screw driver. For applying stains, liquid shellac and varnish, you will need a hair-line artist's brush, also one of medium size, costing five or ten cents each.

A good rubbing block can be made from an old felt hat. Cut out a strip of the brim about 6 in. long and 2 in. wide and wrap this around a small wooden block.

So much for the tools. Now for the materials. At a paint store buy 1 oz. each of walnut-brown and mahogany-red aniline powders, soluble in water. If the dealer does not have them, get household dyes for *wool* in these four colors: brown or seal brown; turkey red, cardinal red or garnet; yellow or orange, and black. Almost any finish can be imitated closely enough for patch work by blending two or more of these colors. Do not get dyes for cotton as they lack the depth and brilliance of the other kind when applied to wood.

FROM your paint dealer obtain a small can of turkey burnt umber ground in oil, ½ pt. liquid orange shellac, ¼ lb. shellac flakes, 1 lb. whiting, ½ lb. FF pumice powder, and (if you haven't them at home) ½ pt. each of alcohol and turpentine, also purchase ¼ pt. liquid glue. A small can of asphaltum varnish is also worth getting; it is an excellent oil stain for varying shades of brown when diluted with turpentine and it imparts a noticeable sheen to the wood.

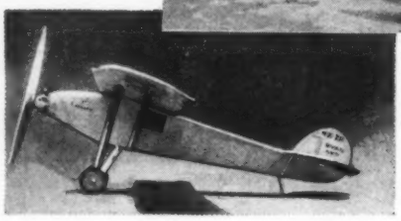
With this outfit you are equipped to do any common touch-up job.

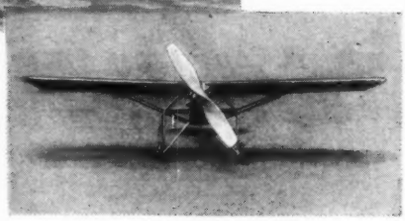
One of the commonest methods of filling deep bruises and dents is to use what is termed "stick shellac." If your paint dealer carries a stock of these sticks, you can buy one for a few cents to match any ordinary furniture finish. The smaller stores often do not have them, so that is why I have advised you to buy shellac flakes. With them you can make your own sticks.

Heat a handful of the shellac flakes in the cover of a (*Continued on page 90*)

How to Make a Flying Model

Like Lindbergh's great monoplane in appearance but with a wing spread of only three feet





Not hard to build and costs little for materials; is driven by strong rubber-band motor

By J. Danner Bunch
and Avison F. Koch

AFTER Colonel Lindbergh's glorious achievement, a prize possession for anyone would be a flying model of his famous Ryan monoplane, the *Spirit of St. Louis.*

The accompanying illustrations show a 3-ft. flying model of the plane. Larger drawings and additional details are contained in Popular Science Monthly Blueprint No. 69 (see page 102).

The materials, which are inexpensive, can be obtained from any dealer in model airplane supplies. For the woodwork one must have clear, straight-grained white pine. The wing ribs and outline pieces are well seasoned split bamboo. To bend bamboo, heat it slightly over a candle and force it into the desired shape with the glossy side on the outside of the curve. White pine is bent in the same manner, but while bamboo is bent dry, white pine must be soaked in water at the point selected for curving. Care must be exercised, especially with pine, to prevent charring or burning while bending. A form for bending can be made when necessary by drawing the curves on a board and driving in nails to hold the material in shape.

THE assembling is done with fine ½-in. brads, white silk thread and glue. To avoid splitting delicate parts, bind their ends and drill holes before driving brads. Every joint should be glued as it is assembled. The tension at the external joints of the undercarriage and wing struts is taken by either Nos. 28 or 30 brass wire.

The first step is to construct the main wing. It requires 12 upper and 12 lower ribs B, 1/16 by 1/16 by 6 in. bamboo. The two spars A are ⅛ by ¼ in. white pine, 36 in. long, set edge up. Beginning 1 in. on each side of the center, bend the spars upward slightly (½ in. altogether) to form a dihedral angle; this insures lateral stability in flying.

A set of ribs is placed 1 in. on each side of the center line; the remaining sets are spaced 3 in. apart, leaving an overhang of 2 in. at each end, around which the tip outlines are to go later.

The upper ribs are bent to an even curve. The greatest height is 2 in. back of the leading edge. The lower ribs have the same sort of curve, but so slight as to be barely perceptible.

To assemble the wing, fasten the ribs to the spars with silk thread and glue. Six wraps of thread each way are sufficient. The same binding holds both upper and lower ribs in place. The front spar is located 1½ in. from the leading edge, the rear spar 3½ in. from the leading edge. After the ribs and spars are assembled, they should be lined up and allowed to dry.

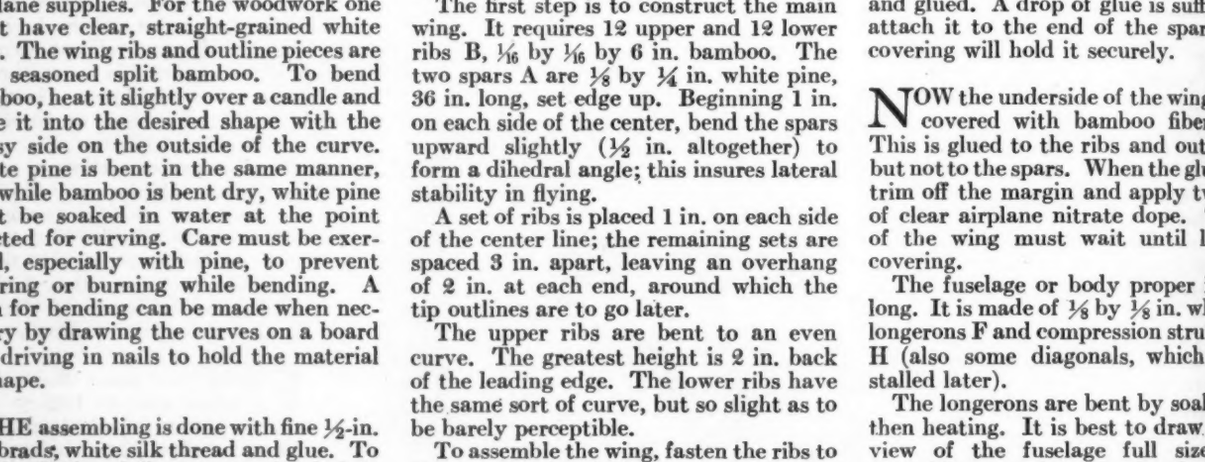
The leading and trailing edges C and D are 1/16 by ⅛ in. white pine placed between the ends of the ribs and secured by six wraps of silk thread tied around the ribs immediately back of the edging, thereby clamping the edging in place. The edging overhangs the end ribs ½ in. To this overhang the outline pieces E, which are 1/16 by 1/16 in. bamboo, are bound and glued. A drop of glue is sufficient to attach it to the end of the spar, as the covering will hold it securely.

NOW the underside of the wing may be covered with bamboo fiber paper. This is glued to the ribs and outer edges but not to the spars. When the glue is dry, trim off the margin and apply two coats of clear airplane nitrate dope. The top of the wing must wait until later for covering.

The fuselage or body proper is 20 in. long. It is made of ⅛ by ⅛ in. white pine longerons F and compression struts G and H (also some diagonals, which are installed later).

The longerons are bent by soaking and then heating. It is best to draw the side view of the fuselage full size before assembling so that the bends may be made accurately.

Assemble the sides first. The nose plate is considered station No. 1. The greatest depth, (*Continued on page 88*)



Front view of the model and details of the wing framework and the strut fastenings; the side and top views are on page 88. Larger drawings and a complete bill of materials are contained in Popular Science Monthly Blueprint No. 69 (see list on page 102)

Better Heating at Lower Cost

An Inexpensive Blower Will Enable You to Burn Cheap Grades of Coal Satisfactorily in Your House Furnace

By CHARLES B. CARLON

MANY POPULAR SCIENCE MONTHLY readers are of an experimental turn of mind and have an intimate acquaintance with home heating plants. They know how high is the cost of operation, how poor the draft with any but the best grades of coal, and how much manual labor is required in tending a furnace. This article on the construction of a blower tells how to attain better home heating at lower cost.

For the past two winters the writer has experimented with forced draft on small sizes of coal—No. 1 and No. 2 buckwheat anthracite and even screenings from the coal yard. No. 1 proves most satisfactory, but run-of-the-mine bituminous served very well during the last strike.

Some of the results have been:

1. Practically perfect combustion.

2. The same number of tons of coal or less.

3. Automatic regulation of room temperature by thermostat, and a comfortable house at any hour, day or night.

4. A saving in cash of half or more in the fuel bill, which more than paid for the equipment the *first* season and will continue year after year with little or no expense for upkeep or depreciation. For example, two years ago during the coal strike, the writer's seven-room house in eastern Pennsylvania required 14 tons of fuel (buckwheat, pea, coke and bituminous) at a cost of $150. After overcoming some of the heat losses in the house by making it more weather tight, it was heated last season, uncomfortably warm most of the time, on 9 tons of buckwheat at a cost of $63. Even crediting the saving in tonnage to lower heat losses, this shows a clear saving of $67.50 over the cost of 9 tons of egg, stove or chestnut at $14.50, as compared with buckwheat at $7, which more than paid for the equipment and cost of operation, not to speak of the greater comfort and convenience.

FORCED draft is not a new idea, nor is it original in this case. Commercial outfits are available at from $125 to $200, but home constructed apparatus works satisfactorily and may be made at from one tenth to one half the cost.

Heating engineers estimate that from 8 to 10 lbs. of anthracite coal per square foot of grate area are necessary per hour to maintain a temperature of 70 degrees inside with zero weather outside. For combustion per square foot of grate area, this coal per pound will need 4 cu. ft. of air per minute. For example, an 18 in. square furnace contains 2¼ sq. ft. of grate and requires 2¼ times 8 times 4 or 72 cu. ft. of air.

Any hot-water or steam heating plant will burn buckwheat coal efficiently with a forced draft

Buckwheat No. 1 contains as much heat per pound as the larger sizes, such as chestnut, egg, and stove, but it forms a dense mass through which the air necessary for combustion cannot pass naturally. A large enough volume to give efficient combustion, if forced in the closed ash pit at a slight pressure, will burn this coal completely, as well as the greater portion of the gases, which usually pass up the stack unburned until the fire has burned through so as to ignite them. Perfect combustion, indeed, is rarely obtainable with large pieces of coal except by sifting and reburning. Much coal is wasted because of shaking the fire in trying to improve a sluggish draft.

With a blower, ash sifting is useless and shaking of the grates rarely necessary. Stirring the fire from above with a straight poker is all that is required, and then only when more room is needed for coal. A layer of ashes on the grate prevents any unburned coal from falling through. The volume of ash is considerably less. When a fire occasionally burns low, it is necessary only to add new fuel, for the draft will ignite even the new fuel that is spread on the burned out sections of the fire. In starting a fire with a blower, spread 3 or 4 in. of ashes on the grates; then kindle a fire as usual, adding coal when the wood has formed a fair bed of live coals. Turn on the blower to ignite the coal.

THIS system is much more rapid than a natural draft. On an 800-ft. hot water system, with 400 ft. of radiation connected, it is possible to raise the temperature from 100 to 140 degrees in less than 20 minutes. With the thermometer at 10 above zero outside and the house at 64, it is possible to have the house at 70 in an hour or less.

A forced draft is entirely satisfactory on steam, hot water, or vapor systems. In connection with hot air or pipeless furnaces, however, this system is apt to give trouble with gas and an induced draft or suction is more satisfactory.

The furnace rarely requires attention more than four times a day, except in very severe weather—on arising in the morning, at noon, in (*Continued on page 139*)

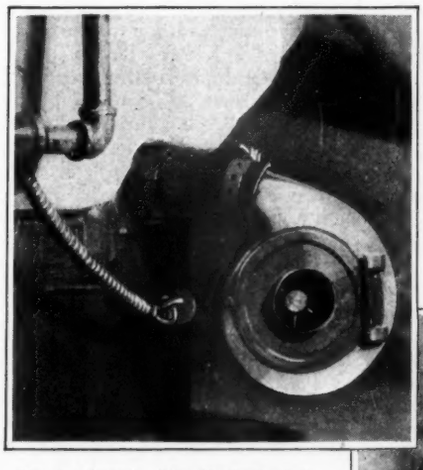


Fig. 1 (above). Mr. Carlon's first blower was made from an old vacuum cleaner, which cost $5. In addition he used a $3.50 rheostat, wire and hardware costing $1, and a $3.50 alarm clock for turning on the forced draft in the morning

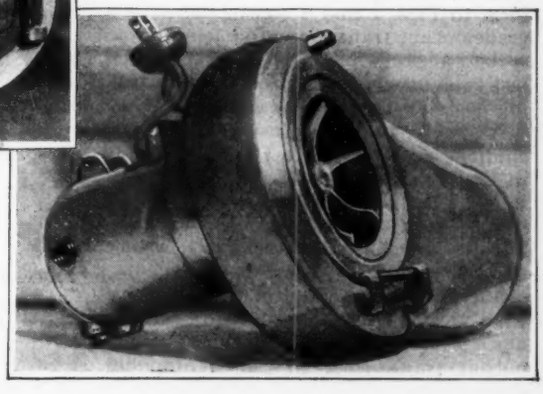


Fig. 2 (at right). The same blower was improved later on by enlarging both the intake and exhaust openings

"B" Power for Your Old Set

How to Adapt the "De Luxe" or a Factory Built Eliminator to Get Better Volume and Quality

By ALFRED P. LANE

THE de luxe B-eliminator described in POPULAR SCIENCE MONTHLY for September was designed to operate, without adjustments of any kind, all modern types of radio sets fitted with a power tube, type 171, in the last audio stage. However, many of our readers are using older types of radio sets equipped throughout with 201A tubes. Of course, the de luxe eliminator will operate such a receiver, but by adding the simple arrangement shown in Fig. 1, you will be able to use the 171 tube with a vast improvement in tone and volume over the 201A now in your set. Furthermore, this arrangement will enable you to obtain these advantages without any alterations to your present radio receiving set.

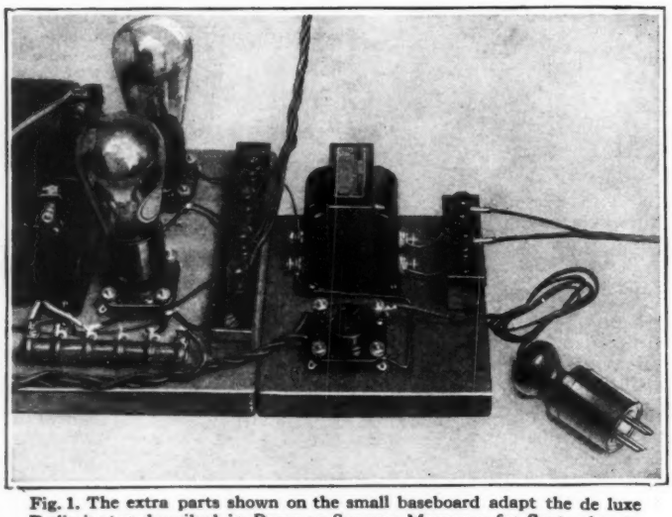


Fig. 1. The extra parts shown on the small baseboard adapt the de luxe B-eliminator described in POPULAR SCIENCE MONTHLY for September to any old style radio set, and allow the use of the 171 power tube without making any changes in the receiver itself. Tone and volume are improved

With the particular circuit used in the hook-up of the apparatus shown in Fig. 1 and illustrated in picture diagram form in Fig. 2, the current to light the filament of the 171 type power tube, which should be placed in the socket next to the output transformer, is obtained from the filament winding of transformer A1 in the eliminator. While difficulties are sometimes encountered in attempting to obtain C-bias voltages from a B-eliminator hooked to a completely wired set, with the filament supply of the power tube operated from a separate filament winding as shown in Fig. 2, you will have no trouble in obtaining the high C-voltage needed for the power tube, nor will any additional filter condensers be necessary.

IF YOUR set requires the use of a small 4½-volt C-battery, do not discard it, because this arrangement supplies the C-voltage only for the power tube.

The additional apparatus you will require to make the de luxe eliminator conform to Figs. 1 and 2 consists of a high grade output transformer, a vacuum tube socket, a special plug to fit in place of the last tube in your set, and a pair of binding posts for the loudspeaker.

Assuming that you have built the B-eliminator according to the instructions in POPULAR SCIENCE MONTHLY for September, the wiring of the new arrangement is extremely simple. After you have fastened the output transformer, socket and binding posts to the extra baseboard, connect the P terminal of the socket to the P terminal of the output transformer, and connect the plus B terminal of the output transformer to the B amplifier binding post of the eliminator. Wire the remaining terminals of the output transformer to the loudspeaker binding posts, as shown in Fig. 2. Now connect the single wire that is attached to the special plug to the G terminal of the socket. Next take a piece of ordinary electric light drop cord and connect the two wires of one end of it to the two filament terminals of the socket. Since you are dealing with alternating current, it makes no difference which wire goes to which terminal. Connect the other end of the drop cord to the five-volt winding on the transformer A1.

The model de luxe B-eliminator was built with resistance M, consisting of a single unit of 13,000 ohms resistance tapped so that the two end sections are 2000 ohms apiece and the three sections between are of 3000 ohms each. If you have such a resistance, move the connections that go to the B minus binding post and the 45-volt binding post along one tap each, and then run a wire from the center tap of the filament winding to the end of the resistance, as shown in Fig. 2. If you used some other type of fixed resistance at M, leave the connections as you have them and procure an extra 2000-ohm fixed resistance. Connect one end of it to the center tap of the filament winding, and connect the other to the B minus post of the B-eliminator.

Next connect the 90-volt, 45-volt and B minus binding posts on the eliminator to the similarly marked posts on your receiver, replace the last tube in your set with the special plug, connect the loudspeaker cord tips to the binding posts as shown, and the outfit will be ready to operate.

The same system can be followed to adapt a commercial eliminator to an old type set merely by adding a small bell-ringing transformer to supply the filament current for the power tube. However, since bell-ringing transformers are not supplied with a center tap, you will have to use a 200-ohm potentiometer to balance the filament winding.

TO ADAPT a factory built eliminator to an old set in this way, first build the attachment shown in Figs. 1 and 2 on the small baseboard. Follow the foregoing instructions except as to filament wiring. Now connect the secondary terminals of the bell-ringing transformer to the filament terminals of the socket, and connect the outside terminals of the 200-ohm potentiometer to these same filament terminals. Wire the center terminal (the one connected to the movable contact finger) to one end of a 2000-ohm resistance, and connect the other end of the resistance to the minus B binding post on the eliminator.

The primary (*Continued on page 94*)

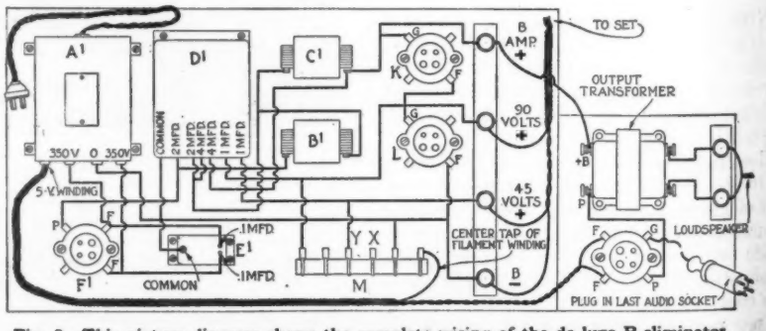


Fig. 2. This picture diagram shows the complete wiring of the de luxe B-eliminator, with the extra parts and wiring changes necessary to adapt it to old style receivers

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Paper Hanging Made Easy

How to Prepare the Walls—Estimating the Number of Rolls Required—Sizing and Pasting—Ceiling Work

By LAWRENCE B. ROBBINS

WALL paper hanging is really a simple job when the essential points are understood. Of course, if very expensive papers and embossed wall hangings are to be used or a number of rooms redecorated, it is better to have the expert services of a painter and decorator, but any amateur can make a passable job of an ordinary room. There is nothing tricky about it. The work simply takes patience, a certain amount of time, and an understanding of the continuity of the processes.

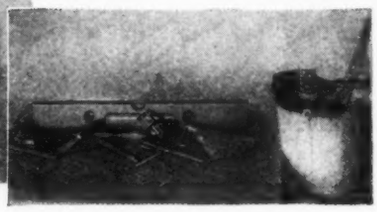
The first move is to measure the room and consult the chart on page 144 to find the number of single rolls of paper 18 in. wide and 8 yds. long you will need. For every two doors or windows of average size, you may deduct a single roll of side wall paper. Under the heading "side wall" you will see three figures. The first represents the number of rolls required if the height of the side wall is 8 ft., the second, if 9 ft., and the third, if 10 ft. high. Allowances have been made for unwaste in matching the design.

Prepared paste, which merely requires to be mixed with water, is the most convenient for the home worker to use. Homemade flour paste is apt to be lumpy unless prepared very carefully. If you wish to make your own paste, however, rub 3 lbs. of flour through a sieve into 2 qts. of cold water and stir thoroughly. Then add 8 qts. of boiling water and boil slowly. Stir for ten minutes, allow to cool and stir in two tablespoonfuls of powdered alum. Be sure that all lumps are removed and that the paste runs easily from the brush.

WASH off all whitewash or calcimine from the ceiling and walls. A wide brush or sponge is best for this purpose. Place an old carpet on the floor as a drop cloth and have the bucket of wash water handy on the ladder or plank you stand on. If the wall finish contains alum, use a solution of warm water and washing soda and then scrape those portions of the finish that do not come off with the washing. Wash the soda solution from all woodwork immediately so it will not soften or darken the paint.

If the ceiling is to be left unpapered, paint or tint it in the usual manner before repapering the side walls. If it is to be papered, wash it anyway and size it, using paperhanger's size mixed with water, or glue size, a formula for which will be given later.

Fig. 1. Soaking old paper to be removed. Fig. 2 (below). The tools necessary, which include paste brush, smoothing brush or whiskbroom, shears, seam roller or caster, plumb or plumb bob and line, hammer, sharp knife and putty knife



Painted walls should be washed with the soda solution and then sandpapered to give the paint a tooth so the sizing will cling. Glue size for this type of wall should have a little washing soda mixed with it.

All new walls should, of course, be sized before any paper is put on them. Otherwise the paste will strike in because of the suction of the porous surface of the plaster. If the wall is rough coated, it may be necessary to go over it with a sheet of rough sandpaper on a block of wood to take off the high spots and ridges. A very rough wall should be sized and then given a coat of paste and allowed to dry.

Fig. 3 (above). A putty knife and painter's scraper aid in taking off the old paper, if it is in such bad shape it must be removed. Hot water is liberally used to soften the old paste

Fig. 4. How cracks and holes are filled with patching plaster or plaster of Paris

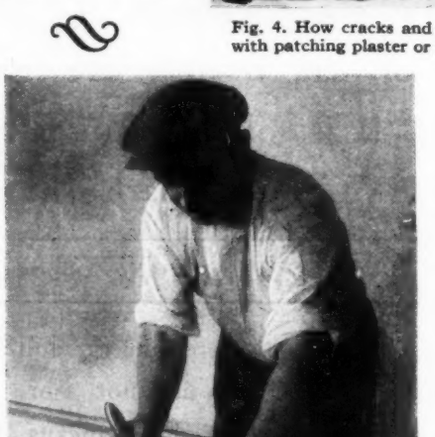


Fig. 5. Lifting the edge of the paper so that no paste will get on the sheet underneath. Apply the paste with long strokes and brush lightly to "lay off" or even up the paste

TO REMOVE old paper from walls is quite a job. It is best, if possible, to have a paperhanger attend to it, especially now that machines are made for taking the paper off quickly. However, the job can be done by anyone with the necessary patience, if the walls are thoroughly wet. Some advocate coating the paper with hot paste and, after the paste has thoroughly soaked in, brushing several times with hot water, allowing a few minutes to elapse between each brushing. The new paste seems to blend with the old and soften it more permanently while the paper is being peeled. A simpler method is to apply hot water alone with a brush, sponge (Fig. 1), or, better still, a garden sprayer of the hand-pump type. The latter has many advantages.

Start at the top and tear the paper down. Remove a layer at a time, if necessary, and where the paper comes off hard, use a wide putty knife. Care must be taken not to dig the plaster, but this can be overcome by inserting only part of the blade under the paper as in Fig. 3.

Varnished papers, such as are used in bathrooms and kitchens, will not respond to the clear water or paste treatment. They should be soaked with water into which has been put a good quantity of washing soda. This cuts the varnish and allows the water to penetrate.

In Fig. 4 is shown the method of filling up cracks and holes in the plaster. Use either plain plaster of Paris or one of the patent patching

(*Continued on page 1*

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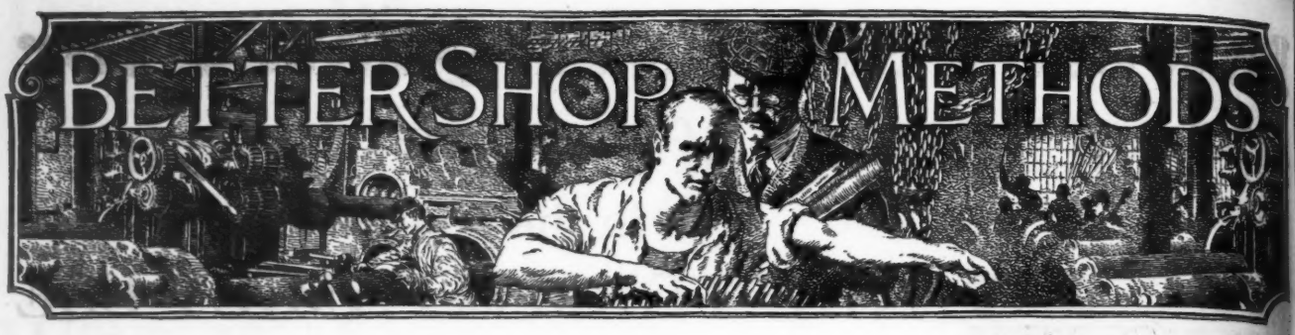

When's a Right Angle *Right?*

A Simply-Made Reference Gage Enables You to Be Sure a Square or Other Ninety-Degree Element Is Correct

By HENRY SIMON

WHILE many things in this world cannot be proved, the conscientious mechanic, like the physicist or chemist, seeks to have proof on as many facts as he can. You may tell a machinist that a milling cutter is hard, but the chances are that he will try his file on it. He is not depending too much on faith when a positive and conclusive method of testing is available.

In the field of measurement more has to be taken on faith. Few men ever see the absolute standards of length from which the commercial standards are derived. Still fewer would be able to divide them into inches and fractions of inches. However, there are several makes of commercial gages that can be checked against each other, and which we believe are correct. They meet every reasonable test. Their permanence is a matter of record, for we have learned how to treat steel so that it will not alter in dimension or shape.

Angular measure, equally important, is another question. There are no standards of angular measure except the commercial square, and every mechanic is familiar with the fact that squares can be bent, or that the slightest abuse will render them worse than useless.

As for checking one against another, the present writer in a previous article in POPULAR SCIENCE MONTHLY has demonstrated that the only thing to be gained by that procedure is to show the sum or the difference of the errors. It is not a conclusive test, and is comparable to trying one micrometer whose frame may be bent, with another, which might be in the same condition or equally faulty.

Extraordinarily accurate as the test angle is, it requires no unusual skill to make and it can be set and checked quickly by means of a large micrometer

Methods of establishing angles less than 90 degrees are well known. Sine bars are in common use, and there is no question as to the accuracy of the resulting angle. However, this method cannot be used to establish or check a right angle, and it is the purpose of this article to show how a right angle for reference purposes can be made, and at any time checked.

The form of the instrument is such that work having either outside or inside angles can be tested with equal ease. The design has been worked out with a view of having accuracy follow naturally from a simple combination of easily made parts rather than be dependent upon delicate operations and extraordinary skill.

In Fig. 1, page 124, the tool is shown assembled. Its principal parts are the skeleton A, which is made of machine steel, ground all over; the two hardened, ground and lapped straight edges or blades, B and C, and the cast iron base D. Base D is for convenience only; it forms no part of the gage other than to hold the skeleton in place while it is being set, or to assist in checking work. The blades B and C are the really important parts, and are the only ones upon which it is necessary to use extreme care.

Figure 2 shows the method of setting the instrument, while Fig. 4 gives the principle upon which the tool is based. As will be seen from Fig. 2, the setting is done by measuring with a large micrometer over two ½-in. balls placed in notches in the ends of the blades B and C. All work should be done with the idea in mind of having everything highly accurate that has any bearing on this measurement.

The base is made of cast iron, and should be finished in about the same manner as any other tool part of cast iron. The two slots for the legs of the skeleton are milled 1/64 in. wider to prevent binding. The set screws, marked 5, are for holding the skeleton (*Continued on page 124*)

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 122 to 134.

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Use Starrett Tools

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Just skimming through the pages of the big Starrett Catalog gives you many a suggestion for doing things better and easier.

All the fine precision tools known and accepted as the standard of accuracy by mechanics and artisans the world over are fully described and illustrated in the Starrett Catalog. And you'll find there also many handy tools for work 'round the house or garage,—such as combination squares, steel tapes and rules, hack saws, nail sets, magazine screw drivers, floor scrapers, etc.

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Write for free copy of Starrett Catalog No. 23 "W." Then ask your tool dealer to show you the Starrett Tools you need.

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Pipe Smoker Applies Medical Training Selecting Tobacco

Some folks act on "hunches," some on emotion, some on pet theories, and still others on cold logic.

Here is a pipe smoker in the "logic" class. And the reason, as he explains, is that for three years he has been taught to take nothing for granted, but to prove his way as he goes.

427 Lyons Avenue
Newark, N. J.
Oct. 16, 1926.

Larus & Bro. Co.
Richmond, Va.
Gentlemen:

Most medical students by the time they reach the third year of their work have absorbed the scientific spirit. That is, we take nothing for granted unless it has been confirmed by experiment or other reliable means. Prove it, we say!

Some time ago I decided to start smoking a pipe. Choosing the pipe was easy enough, but finding the tobacco to go with it was not so easy. I experimented, trying one tobacco after another. Some would have a fragrant aroma, but oh—what a taste they would leave! Others left my mouth like a furnace. A few reminded me of a poorly ventilated chemical laboratory.

I had almost decided that what I was looking for—a cool, sweet taste and a pleasant aroma—was impossible. Finally, I took the advice of one of the fellows and tried your good ole blue can. Eureka! You can't get me away from it now.

You should call Edgeworth—"money's worth."

Sincerely yours,
Irving H. Plaine

To those who have never tried Edgeworth we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10 S. 21st Street, Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

On your radio—tune in on WRVA, Richmond, Va.—the Edgeworth Station. Wave length (254.1 meters.) 1180 kilocycles.

Finishing Your Ship Model

Artistic Touches That Add Beauty and Value—"Billowing" the Sails—Painting Flags

By A. W. EIDMAN

The hull is given a weatherworn aspect and set at a slight angle in its cradle. The sails are warped out of shape and sprayed with lacquer

HERE'S our ship model in front of us, just about finished. We feel mighty proud of our handiwork, but there seems to be something missing. Let's see if we can't add a touch here and there that will give more life to our model.

Have we ever seen a ship under sail ride the waves as our model rides her cradle? No, she's a bit too squarely placed to appear natural. With knife and file we'll shave down the arms of the cradle till the ship is heeling a trifle as if under the wind and the prow is lifting slightly. If our craft is inclined about one half a degree from the horizontal (the stern the lower end) and the line of the masts is two degrees or so from the vertical (away from the wind), we'll see her rolling the waves, with masts bending before the wind and blocks creaking.

Is the brass work shining? Is the anchor bright and new, the paint spic and span, and the sails clean? Then we'll have to help out Father Time. The forged ironwork will be given a daily spray of salt water with the family atomizer until a light coat of rust is formed.

On the brass and copper work an application of the following solution will produce a beautiful green patina or tarnish such as our boat's brass work would have if it had been to sea for years: ⅜ oz. crystallized iron chloride, 2 oz. ammonium chloride, 1 oz. verdigris, 1¼ oz. sodium chloride, ½ oz. potassium bitartrate (cream of tartar), 16 oz. water. These chemicals usually may be obtained from the corner druggist. Apply this solution to the clean metal with a soft brush, and allow it to dry. Several applications may be necessary. After the patina has been built up to the desired thickness, it may be stippled with a damp brush to get the variegated color that we find only in old bronzes.

The paint also is too clean to be realistic. By borrowing an air brush from our friend the artist, or even using a small garden spray, an atomizer, or a fixative blower, we can coat the odd nooks and corners with a highly thinned, dark-colored lacquer, either of the spray or brush type. This will give the paint a weathering of a dozen years. A light rub-down with felt and a paste of rottenstone and water will even up the irregularities of the air brush work and form beautiful high light effects.

AT MANY points on the real ship the paint would have been worn thin and the wood beneath exposed. On many of the old-time ships, for example, the anchor was swung up over the gunwales while at sea. Chafed rails and timbers were inevitable. At every such point we'll carefully scrape away paint and wood.

Now that the sails have been cut to size and the needle work finished, we're about ready to tackle the process of "billowing." First we'll slit the mainsail in one or more places with a penknife, and, perhaps, cut out a section and neatly "repair" the damage with needle and thread.

By alternately stretching opposite corners of the sail with the fingers, we can give the cloth a warped surface. An alternative method is to tie down the corners of the sail over *(Continued on page 138)*

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Leaky roofs *made good as* New!

THERE is no need now to pay for frequent roof repairs, new roofs or leak damages. No more roof troubles! Rutland No-Tar-In Roof Coating (or Rutland No. 4 Paste) stops leaks instantly—it makes an old roof like new, or a new roof much better.

Rutland No-Tar-In Roof Coating is easy to apply. It requires no mixing, thinning or heating. You can stop the leak as soon as it is discovered. No matter what sort of roof or surface, or at whatever angle, it is equally effective.

Does not sag, harden, peel or blister

RUTLAND No-Tar-In Coating provides a perfect roof of asphalt and asbestos—*a tough mineral covering.* Not a drop of tar in it. It will not crawl, sag, harden, peel or blister. It is not affected by acids, rust, decay or corrosion. The coating is elastic—adapts itself to the expansion and contraction of the roof.

Save money—year after year

WITH Rutland No-Tar-In you can keep your roof watertight with minimum attention and maintenance expense. This is property protection at lowest cost! There are also over 30 other uses, such as waterproofing foundation walls.

It will pay you to insist upon Rutland No-Tar-In Roof Coating (or No. 4 paste) at your hardware or paint store. Save money by mailing the coupon today.

RUTLAND FIRE CLAY COMPANY
RUTLAND, VERMONT

Rutland
No-Tar-In ROOF COATING

Mail this coupon for complete information

RUTLAND FIRE CLAY CO., Dept. R-14, Rutland, Vermont
Without obligation, please send me more information about No-Tar-In, with name of nearest dealer.

*Name*_____

*Address*_____

*My dealer's name*_____

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Most Men Shave *the Wrong Way*

They use a blade a few times, throw it away and use a new one. That's wrong! They don't get nearly as good a shave with the new blade as they would if they stropped it before the first shave. Then they put up with a second, third and fourth rate shave on the second, third and fourth days. And finally they throw away a perfectly good blade with a lot of good shaves in it.

A Twinplex Stropper would completely change the shaving ideas of these men. (Maybe you are one of them.) A few turns and Twinplex puts an edge on a new blade that is a dream for smooth shaving. And ten seconds' stropping each day before shaving will make that one new blade shave marvelously for weeks and weeks.

You'll find Twinplex will make shaving easier, quicker, cleaner and vastly more comfortable. You can now buy a Twinplex for as little as $2.50—less than a year's saving on blade purchases. Other Twinplex models $3.50 and $5.00

Send For Stropped FREE *Blade*

Name your razor and we will send you a stropped blade free. We would just like to show you what Twinplex can do to a new blade.

TWINPLEX SALES CO.
1760 Locust St., St. Louis

New York Montreal Chicago London

Twinplex Stroppers
FOR SMOOTHER SHAVES

A Gift to Win *My Lady's* Heart

How to Build a Boudoir Cabinet of Unusual Grace and Beauty

By Charles A. King

Fig. 1. So charming a little piece as this is certain to become a valued heirloom

WHAT wife, sister or daughter would not value highly this dainty little cabinet, which will just fit a niche or corner in even the smallest boudoir? What young girl would not consider this cabinet a wonderfully desirable equivalent for a real grown-up hope chest? She would ever find new pleasures in filling and refilling it and rearranging its contents as the changing and individual interests of her life develop.

The cabinet may be made of almost any hard or moderately hard wood—maple, birch, oak, mahogany or sweet gum, the last of which is a wood of beautiful color and texture and easily worked. The project is suitable for an advanced manual training student or a home worker who has a fairly complete set of cabinet-maker's tools at his command, and can work skilfully to accurate knife marks. The cabinet is a worth while objective for the exercise of such skill, for, if well made, it will be cherished by succeeding generations. A larger cabinet, more suitable for a larger room, may be made of the same design by changing the given dimensions judiciously.

All construction pieces should be of white wood, poplar or similar wood and will be marked "con." in the following list; other pieces should be of the wood of which the visible cabinet is to be made. The parts needed are:

One piece for the top of the drawer case A (Figs. 2 and 3), 1 by 6 by 25 in. Two pieces for the top returns A^1, 1 by 4 by 8 in.

Two pieces for the front legs, 1⅞ by 1⅞ by 23 in., and two for the back legs, 1⅜ by 1⅞ by 23 in. Two end panels, ⅞ by 9½ by 12½ in.

Two pieces for base scrolls at ends, ⅞ by 3¾ by 10¾ in. Four pieces for the sides B, Fig. 2, ½ by ⅞ by 12¾ in. Two pieces for top fillers C, Fig. 2, ⅝ by ⅞ by 10¾ in.

Three pieces for drawer partitions D (con.), Fig. 3, ¾ by 2¼ by 22⅝ in. Two pieces for drawer partitions D^1 (con.), ⅝ by 2¼ by 22⅝ in. One piece for drawer partitions E (con.), ¾ by 1⅝ by 22⅝ in. Two pieces for drawer partitions D^2, face wood, ⅛ by 2¼ by 22⅝ in. Four pieces for partitions D^3 (con.), ¾ by 2¼ by 8⅝ in. Four pieces for partitions D^4 (con.), ⅝ by 2¼ by 8⅝ in.

Two pieces for leg stiles F, Fig. 4, ⅜ by 1⅜ by 12¾ in. Glue to leg as shown in details U and V, Fig. 5.

One piece for the front base scroll, ⅞ by 3¾ by 22⅜ in.

Two pieces for back rails (con.), ½ by 2¼ by 21¾ in.; three for back muntins (con.), ½ by 2½ by 11¼ in., and two for back panels (con.), ½ by 7⅜ by 11¼ in. Allow ⅛ in. in width of panels for swelling.

(*Continued on page 135*)

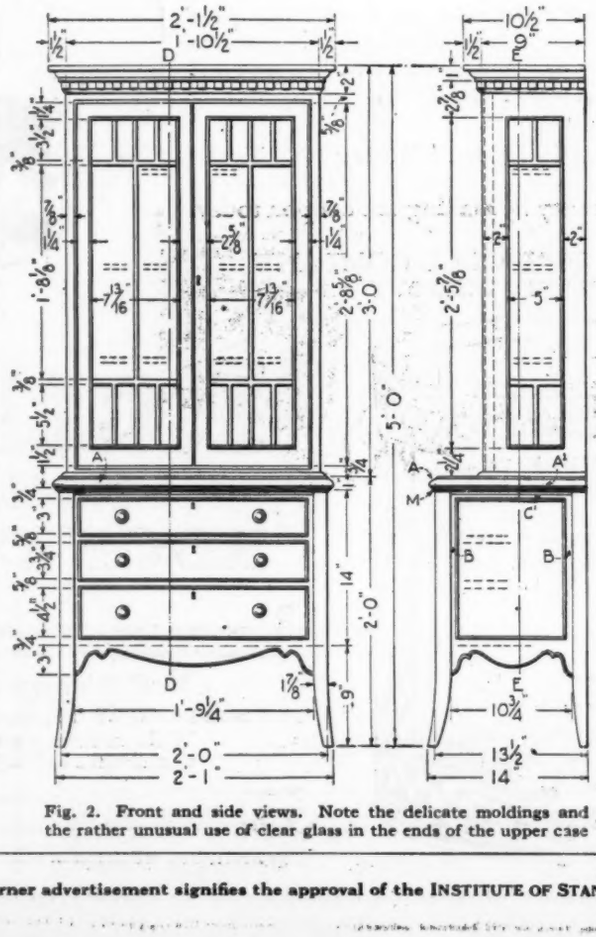

Fig. 2. Front and side views. Note the delicate moldings and the rather unusual use of clear glass in the ends of the upper case

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

30 DAYS FREE TRIAL

7 Tube Set Single Dial Radio

Metrodyne Radio Sets
Are Equipped For
BATTERY or ELECTRIFIED operation

The Metrodyne
ONLY ONE DIAL TO TUNE

RETAIL PRICE
$75.00
Completely Assembled
Big Discounts to Agents and Dealers

Wonderful offer direct from the factory! Marvelous radio set! A perfect working, single dial control, 7 tube receiver! And just to prove our claims, we will ship it to your home for **30 days' free trial.** Test it under all conditions. Test it for distance, volume and tonal quality—and if you are not convinced that it is the **best single dial set you ever heard,** return it to the factory. We don't want your money unless you are completely satisfied.

Three Year Guarantee

BIG PROFITS TO AGENTS AND DEALERS
Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon, a letter or a postal for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. **Tested and approved by Popular Science Institute of Standards, Popular Radio Laboratory, Radio News Laboratory** and by **America's leading Radio Engineers.** Designed and built by radio experts. Only the high quality low loss parts are used. Magnificent, two-tone walnut cabinet with beautiful, gilt metal trimmings. Very newest 1928 model, embodying all the latest refinements.

An easy set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, **1,000 to 3,000 miles on loud speaker!** The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.

6 Tube Set $48.50 RETAIL PRICE Completely Assembled

30 Days' Free Trial—3 Year Guarantee

Metrodyne Super-Six

Another triumph in radio. Here's the new 1928 model Metrodyne 6 tube, two dial, long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. High grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station on same dial readings every time — no guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal 30 days' free trial offer, which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis.

MAIL THIS COUPON or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer — SAVE MONEY—WRITE NOW!

METRO ELECTRIC COMPANY

2161-71 N. California Ave. • Dept. 52 • Chicago, Illinois

MAIL COUPON BELOW

Let us send you proof of Metrodyne quality—our 30 days' free trial offer and 3 year guarantee

Mrs. Wm. Laflingwell, Westfield, N. J., writes: "The Metrodyne Radio I bought of you is a wow! This is as good as any $225 machine I have ever seen."

N. M. Greene, Maywood, Ill., writes: "My time is up and the Metrodyne works fine. I got Havana, Cuba, Oakland, Calif., Denver, Colo., Toronto, Canada, all on the loud speaker."

J. W. Woods, Leadville, Colo., writes: "Received the 7-tube Metrodyne in fine condition. Had it up and working same day received. Was soon listening to Los Angeles, San Diego, Oakland and other California points; also St. Louis, Kansas City and other east and south stations—all coming in fine. Am more than pleased. Sure enjoying it."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer.**

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 52
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer.**

*Name*_____

*Address*_____

If you are interested in AGENT'S proposition, place an "X" in the square ➡ ☐

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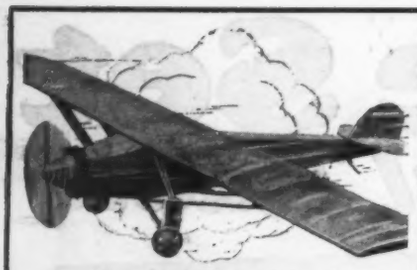


Build This Ideal Flying Model of

LINDBERGH'S

"Spirit of St. Louis"

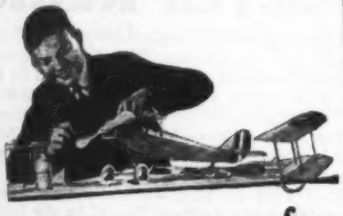
New York-Paris Monoplane

HERE'S an accurate, scale-reduction Model of the famous Monoplane of the "We" partnership! A miniature duplicate with parts and fittings like the original. 3 ft. wing spread, and guaranteed to rise from the ground under its own power and fly in the air when correctly constructed. Anyone can build it; the Ideal Complete Construction Outfit contains everything needed; including all wood and reed cut to size; hand-carved propeller; rubber-tire disc wheels; ball-bearing propeller shaft; aluminum cowling, wing struts, nose-piece, sleeves and 'plane holders—even parts to imitate the motor. Also half-size drawn-to-scale plans, with diagrams and full building and flying instructions. Get this Outfit and save time and trouble in building your Model.
Complete Construction Outfit **$7.50**

Ask Your Dealer, or Order Direct if Unobtainable. West of Denver, Colo., and in Canada, add 50c to above price.

Plans for Model Airplanes

The Plans and Building-Flying Instructions show what is needed and how to proceed. For those who desire to build with materials at hand, or ordered as needed, we supply Plans and Instructions alone for..... **25c** Postpaid, including Catalogue



Headquarters for Model Airplane Parts, Supplies and Materials

WE HAVE the most complete stock of Model Airplane parts, fittings and materials, all specially manufactured or selected to duplicate in miniature the actual parts of real Airplanes; also supplies of everything needed by Model builders. No matter what type of Model you are making, you can save time and trouble and make more accurate and practical Models by using Ideal parts and materials. Our big catalogue is the most complete list of items ever published; contains descriptions and prices of over 500 separate items of parts, fittings, materials and supplies for builders of Model Airplanes. Get your copy now and see how you can build easier, quicker and better.

Send 5c for Big, 48p. CATALOGUE!

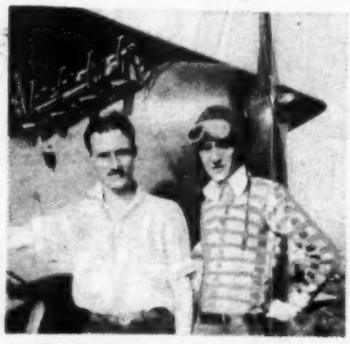
IDEAL AEROPLANE & SUPPLY CO.

Established 1911—16 years ago
163-165 Spring St., New York City

How to Make a Flying Model

(Continued from page 76)

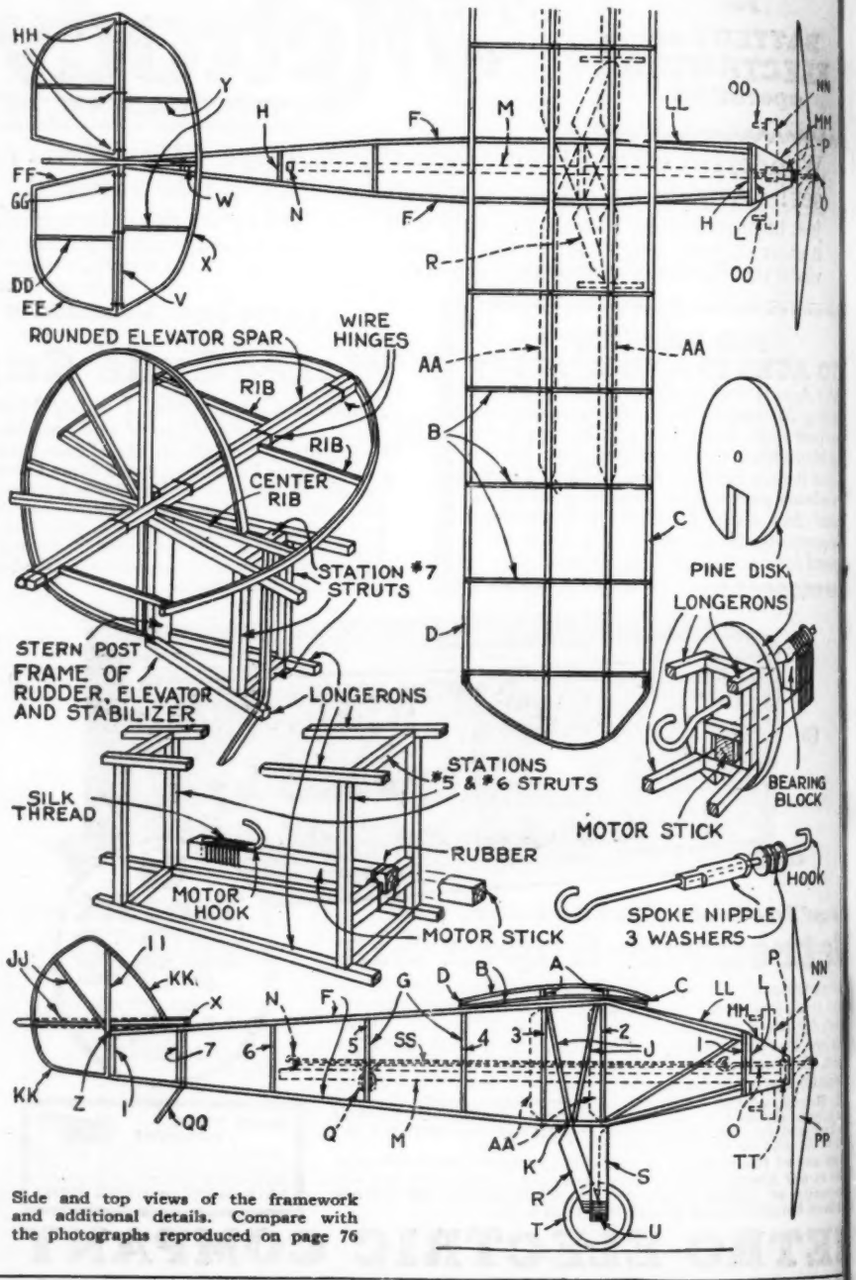
which is 4 in., falls at station No. 2, 4½ in. back of this. At station No. 3, 2 in. behind station No. 2, the top longerons are lowered ¼ in. to give the proper angle of incidence or attack to the wing. The top longeron continues to drop at this angle progressively to the sternpost I. At station No. 3 the lower longeron raises ⅛ in. and from station No. 3 continues in a straight line to the sternpost, which is 1¼ in. long.



Bunch (left) and Koch, who designed the model, are aviators

Working forward to the nose, the upper and lower longerons lower and rise respectively at the same angle to the nose strut. At station No. 1 the fuselage is 1½ in. deep. The top and bottom of the fuselage is 1 in. wide at station No. 1. At stations Nos. 2, 3 and 4, it is 2 in. wide, and from there it converges progressively to the sternpost, at which point the longerons meet.

The strut spacings are as follows: Between 1 and 2, 4½ in.; 2 and 3, 2 in.; 3 *(Continued on page 147)*



Side and top views of the framework and additional details. Compare with the photographs reproduced on page 76

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

You have a dozen uses for this drill

Every time you have a job to do that requires drilling a Millers Falls Electric Drill should be in your hands. Quickly, easily, accurately, in the time you used to take to get ready, the hard part of your work is done.

Automobile repairs, radio construction, electrical fixture work, drilling in tile (for bathroom fixtures, for instance), working on metal doors and window frames, these and many other jobs are all made to order for this drill.

Hardware dealers selling Millers Falls Tools will be glad to demonstrate Millers Falls Electric Drills. Try them out. See how easily they handle. Years of making hand and breast drills have taught us how to design and build drilling tools. Years of service have been built into each Drill. Made in three sizes—No. 414, ¼ inch—No. 538, ⅜ inch and No. 612, ½ inch. Nos. 538 and 612 are made with detachable side handles, adjustable spade handles and breast plates.

Specifications: Portable Electric Drill No. 414 (shown above)

MOTOR, Universal—operates on D. C., or on A. C., up to 60 cycles • SPEED, No load 1800 R. P. M. 1.2 Amps • CAPACITY, 0-¼ in. in steel, 0-⅜ in. in cast iron, 0-⅜ in. in wood • Furnished for 110 or 220 volts • Jacobs heavy duty chuck • Heat treated alloy steel gears • Ball thrust bearing on spindle • Armature mounted on high grade ball bearings • Automatic switch mounted on handle • Armored attachment plug • Aluminum housing efficiently ventilated • Pig-tail brushes (not usually found in drills of this size) • Easily replaced from outside without taking tool apart • Grease lubrication throughout • 8 feet best quality rubber covered cord furnished • Spindle offset for close boring—1¾ in. from outside of housing • Weight 5½ lbs. net • Overall length 12 in. • Packed one in a heavy corrugated box • PRICE • 110 Volts, $30.00.

MILLERS FALLS TOOLS

MILLERS FALLS COMPANY MILLERS FALLS, MASS.
NEW YORK, 28 WARREN STREET CHICAGO, 9 SOUTH CLINTON STREET

MILLERS FALLS TOOLS SINCE 1868

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WURLITZER

"Bill Carola" Landau Serenaders

Couldn't Play a Note—

Now Makes $100.00 a Week

"When I sent for your catalog, I didn't know a note of music. A few months after I bought my Wurlitzer instrument, I had taken my place in a professional orchestra. Now I am making $100 a week, three times what I made as a clerk. I wish everybody knew how easy it is—anyone who can whistle a tune can learn to play a musical instrument."—*Bill Carola.*

Free Trial—Easy Payments

You may now have any Wurlitzer instrument for an ample free trial in your own home. Examine the instrument, note the fine workmanship, the full, rich tone value and especially how easy it is to play. No obligation to buy—no expense for the trial. We make this liberal offer because we want you to try for yourself a genuine Wurlitzer instrument, the result of 200 years' experience in musical instrument building.

Easy payments are arranged to suit your convenience. This is your opportunity to try a famous Wurlitzer instrument in your own home.

Send for **Free Book**

Illustrates and describes every known musical instrument—more than 2000 articles, many of them shown in full colors. All genuine Wurlitzer instruments—buy direct from Wurlitzer and save money. Special offers on complete outfits.

We also give you our Free Trial, Easy Payment Plan, No obligation.

Send Coupon Today!

Send this Coupon

The Rudolph Wurlitzer Co., Dept. 1787
117 E. 4th St. Cincinnati 329 S. Wabash Ave. Chicago
120 W. 42nd St. New York 250 Stockton St. San Francisco

Send me your Free Book on musical instruments. Also your Free Trial, Easy Payment Plan. No obligation.

Name .....

Address .....

City ..... State .....

Instrument .....

WURLITZER

Copyright, 1927, The Rudolph Wurlitzer Co.

Patching Damaged Furniture

(*Continued from page 75*)

Mr. Fraser, who was once a furniture inspector for the United States Government, shows how to rub a blemish with pumice stone and oil (at left) and how to use shellac stick (below)

coffee can or other receptacle. As they begin to melt, stir them with a screw driver or the handle of an old spoon to keep them from burning on the bottom. While stirring, pour in a little aniline stain powder of the color you wish the stick to be and blend this thoroughly with the simmering shellac. You may have to put in two different colors in order to secure the desired shade.

As soon as the mixture suits you, pick the cover up with a pair of pliers and scrape the soft mass out on to a hand saw blade. It will cool rapidly. While it is still pliable, scoop it up with the fingers and roll it briskly between the palms of the hands to form a long pencil-like stick. Lay the stick down upon the saw and in a minute the shellac will be as hard and brittle as an icicle.

To use the stick, heat a screw driver point enough to melt the shellac without causing it to boil. Hold the stick at the edge of the cavity, as illustrated above, with the screw driver point bearing gently down upon the corner of the shellac, much as you would solder metal parts, and force the hole full.

Damp a finger and quickly pack the soft shellac down. Burn on a little more, and pack again, until the filling rounds up slightly above the surface. Be careful all this time not to let the hot iron touch the surrounding varnished surface. Then with a knife or chisel held flat, carefully pare away the surplus shellac, and smooth with the rubbing felt, as described a little later.

The correct way of filling a hole or crack

Sealing wax also can be used as a filler. This is to be had in various colors at stationery stores.

Another excellent filling agent is what is called "gesso." In fact, gesso makes a tougher and more durable filler than shellac stick. To make a small batch, fill a tablespoon with liquid glue, and pour this into any small vessel, such as the cover of a baking powder can. Add an equal amount of whiting. When the two substances are well blended, put in a little aniline stain powder of the desired color and stir until the composition is of a uniform color throughout. The gesso is then ready to apply.

Take up a small quantity on the corner of a putty knife or table knife and press it firmly into the cavity. Pack the hole full, rounding it over a trifle to allow for shrinkage. With a damp cloth pulled over the forefinger, carefully remove any of the filler that may have gotten on the surrounding varnished surface. By the next morning the gesso will have hardened until it is like rock, yet with a sharp knife or chisel you can easily shave off the surplus. Pumice and oil are used for the final smoothing.

YOU can obtain in many hardware and paint stores a plastic wood filler that is excellent for repair work. It is probably best used in the natural color, which is light, and then tinted after it has been dressed smooth. It hardens very quickly and, because of its adhesive qualities and strength, can be used in building up broken corners and replacing missing bits of carving or molding. It can be modeled into any shape with the fingers.

Still another good filler is made from glue and wood dust. Mark that I do not say *sawdust*, which is too coarse. Take a cabinet file and a piece of scrap wood of a kind to match in color the part containing the cavity. Fasten the wood in the vise and stretch a cloth on the floor beneath. File away like a good fellow and in a little while you will have a sufficient deposit.

Place the wood dust on a scrap block or in a saucer, and pour on enough hot or cold glue to make a paste. Then add sufficient aniline stain powder to produce a color to match the furniture exactly. Use it like gesso.

Such blemishes as scuffs and shallow scratches occur more frequently to furniture than any other kinds of damage, and, fortunately, are the easiest to remedy. As a rule the (*Continued on page 92*)

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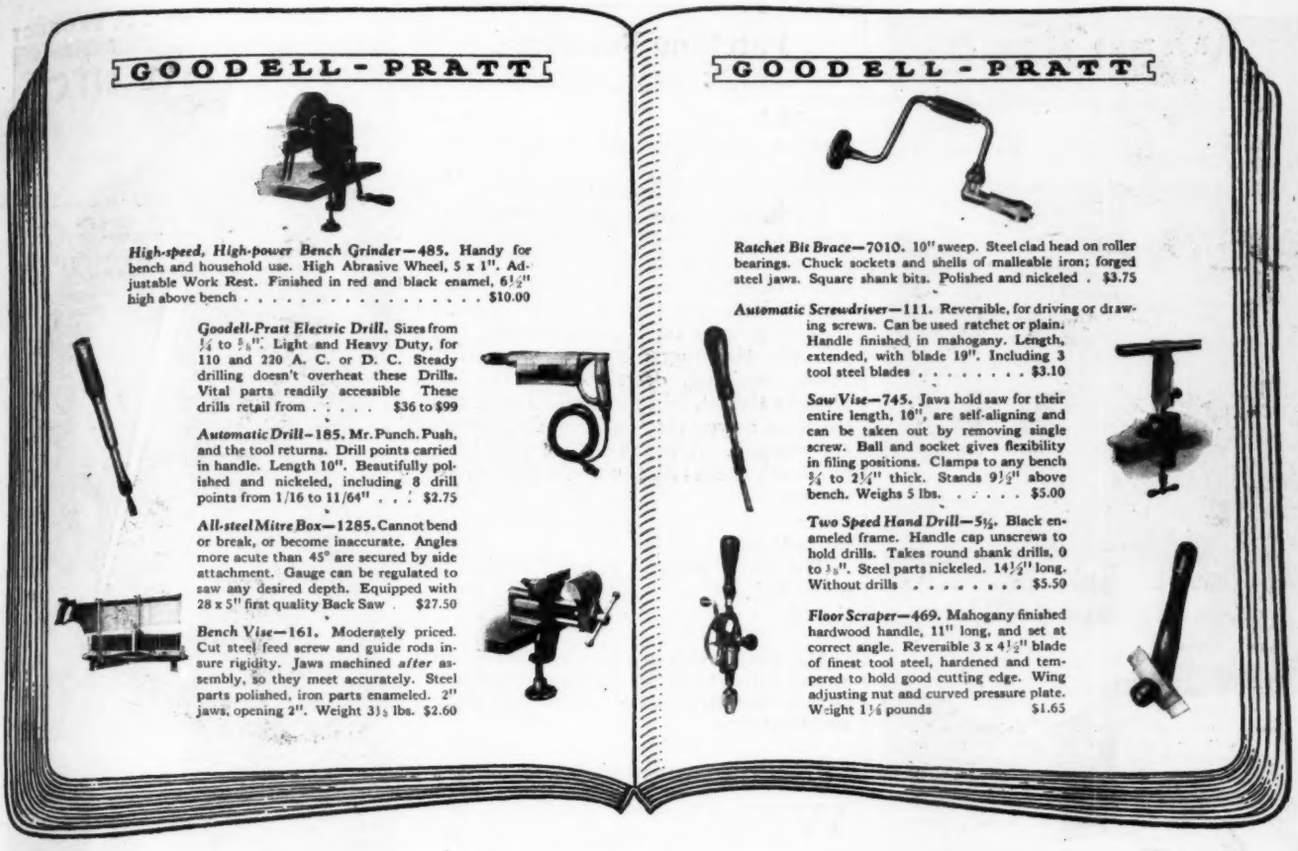

GOODELL-PRATT
High-speed, High-power Bench Grinder—485. Handy for bench and household use. High Abrasive Wheel, 5 x 1". Adjustable Work Rest. Finished in red and black enamel, 6½" high above bench $10.00
Goodell-Pratt Electric Drill. Sizes from ¼ to ⅜". Light and Heavy Duty, for 110 and 220 A. C. or D. C. Steady drilling doesn't overheat these Drills. Vital parts readily accessible These drills retail from . . . . $36 to $99
Automatic Drill—185. Mr. Punch. Push, and the tool returns. Drill points carried in handle. Length 10". Beautifully polished and nickeled, including 8 drill points from 1/16 to 11/64" . . . $2.75
All-steel Mitre Box—1285. Cannot bend or break, or become inaccurate. Angles more acute than 45° are secured by side attachment. Gauge can be regulated to saw any desired depth. Equipped with 28 x 5" first quality Back Saw . $27.50
Bench Vise—161. Moderately priced. Cut steel feed screw and guide rods insure rigidity. Jaws machined after assembly, so they meet accurately. Steel parts polished, iron parts enameled. 2" jaws, opening 2". Weight 3⅓ lbs. $2.60
GOODELL-PRATT
Ratchet Bit Brace—7010. 10" sweep. Steel clad head on roller bearings. Chuck sockets and shells of malleable iron; forged steel jaws. Square shank bits. Polished and nickeled . $3.75
Automatic Screwdriver—111. Reversible, for driving or drawing screws. Can be used ratchet or plain. Handle finished in mahogany. Length, extended, with blade 19". Including 3 tool steel blades $3.10
Saw Vise—745. Jaws hold saw for their entire length, 10", are self-aligning and can be taken out by removing single screw. Ball and socket gives flexibility in filing positions. Clamps to any bench ¾ to 2¼" thick. Stands 9½" above bench. Weighs 5 lbs. $5.00
Two Speed Hand Drill—5½. Black enameled frame. Handle cap unscrews to hold drills. Takes round shank drills, 0 to ⅜". Steel parts nickeled. 14½" long. Without drills $5.50
Floor Scraper—469. Mahogany finished hardwood handle, 11" long, and set at correct angle. Reversible 3 x 4½" blade of finest tool steel, hardened and tempered to hold good cutting edge. Wing adjusting nut and curved pressure plate. Weight 1⅛ pounds $1.65

THE ten carpentry tools pictured here are single examples of the sizes in which each is made. The catalog also features all kinds of tools for machinists, and professional and amateur mechanics.

400 pages of fine tools *FREE*

Select your tools from this catalog—then buy them from your hardware dealer, mill supply or automotive supply dealer

THIS 400-page catalog is used by carpenters, mechanics, and machinists—who select from its pages the tools they need—and buy them through their local hardware or mill supply man.

You, too, will find this a pleasant and easy way to buy tools. A three-page index helps you find what you want—at once. Clear, easily understood descriptions and good pictures leave nothing for you to guess at.

Whether you make your living with tools or use them to follow a hobby, you need this booklet, with its 400 pages of pictures and information.

Goodell-Pratt Tools will serve you well for years. No finer tools are made than those that bear the name of Goodell-Pratt.

Select your needs from this catalog; then buy them from your nearest dealer. If he doesn't carry the Goodell-Pratt line, write us for the name of a dealer who can supply you.

For the catalog, address Ⓘ

GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

MAKERS OF *Toolsmiths* MR. PUNCH

GOODELL-PRATT

1500 GOOD TOOLS

Ⓘ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

$1800 in cash prizes

for the best uses of this colorful fibre-tile

IMAGINE your kitchen tiled in a warm corn yellow or a cool green.

Your bath in the fashionable mode of gray and black. Upson Fibre-Tile is inexpensive, easily erected in big room-wide sections — waterproof — washable!

49 CASH PRIZES—$1800 in all—will be given for best photographs, descriptions and suggestions for use of Upson Fibre-Tile in homes, stores, factories or business. Mail coupon for rules and helpful suggestions.

UPSON fibre TILE

THE UPSON COMPANY
1057 Upson Pt., Lockport, N.Y.

Please send me FREE, booklet giving rules of $1800 Prize Contest, together with Upson Fibre-Tile and Upson Board samples, helpful suggestions and name of nearest Upson lumberman.

NAME .....

ADDRESS .....

Identify genuine Upson Board by the famous *Blue* Center.

Patching Furniture

(*Continued from page 90*)

varnish is scored sufficiently to dull it or give it a white appearance, the latter being most noticeable in pieces that have been coated with a cheap grade of varnish.

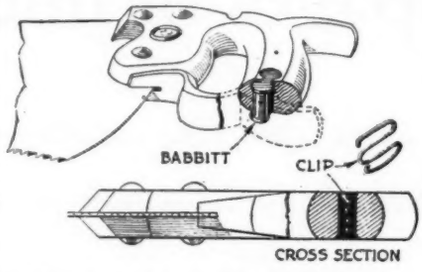
If your examination convinces you that the stain coat has not been cut through, all you will have to do is to sprinkle a few drops of sewing-machine oil or olive oil on the damaged surface, shake a little pumice powder on the same place, and rub the two ingredients with the felt block previously described. If the felt absorbs the oil, add more oil. Don't rub too long, as you may cut entirely through the varnish. A dozen firm shoves back and forth should do the work. Some jobs of this nature you can efface entirely; others will always show a little on close inspection.

The same method is used after the other filling treatments previously mentioned.

Mr. Fraser will tell how to doctor up many other kinds of surface blemishes in another article scheduled for early publication.

Repairing a Split Saw Handle

WHEN a handsaw or compass-saw handle becomes cracked and a new one cannot be conveniently obtained, a repair often may be made as shown. Two



The parts are keyed together with babbitt

5/16 or 3/8-in. holes are bored close together and saw cuts made between them and across the crack. The holes are countersunk on both sides of the handle. A short piece of wire or a paper clip is bent and placed as indicated; then melted babbitt metal is poured into the opening and pressed down with a flat iron just before it has become cold. It is dressed with a file and fine sandpaper.

If necessary, the handle can be taken from the saw blade to make a repair of this kind. Cardboard is slipped in the slot to fill the space intended for the blade.—GEORGE H. CAPPEL.

FROSTED effects on glass are sometimes obtained by the simple expedient of applying glue or gelatin to the surface. Usually a small amount of alum is added to the glue. As the glue dries, it tears away from the surface of the glass in a fern-like effect. The appearance of the frosted pattern varies according to the strength and kind of glue or gelatin. By the use of a suitable stencil, the glue can be applied in any desired design.—L. C.

A . . . LABORATORY . . . PRODUCT

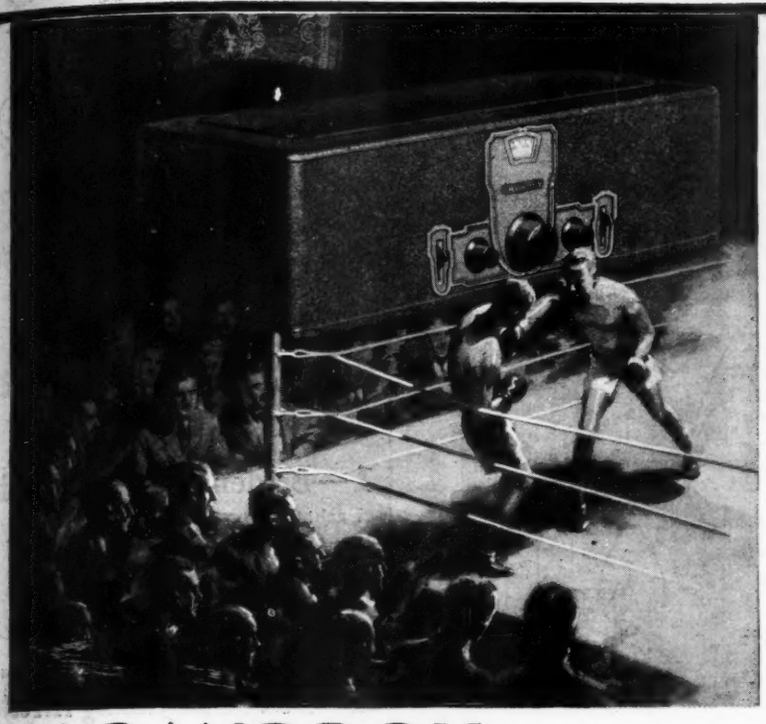
With a Blade of LIGHT he slew the Greatest of all Demons~ DARKNESS

BURGESS BATTERY COMPANY
GENERAL SALES OFFICE: CHICAGO
Canadian Factories and Offices
Niagara Falls and Winnipeg

BURGESS FLASHLIGHTS & BATTERIES

—when the crown stands or falls....

"—You're *there* with a Crosley..."



The Crosley Radio Corporation:
Folks who buy radio are vitally interested in what they get for their money. Why don't you radio manufacturers stop talking like a lot of doctors and tell us what it's all about in one cylinder words? What's this "shielding" business anyway?
Yours truly,
Dutton, W. M. & Co.,
Hastings, Neb.

The BANDBOX

A 6 Tube Receiver *of* unmatchable quality at $55

LIGHT SOCKET MODEL $65

Many features of this set have been found heretofore only in the most expensive radio. Since Crosley is licensed to manufacture under nearly all important radio patents, this combination with Crosley leadership and experience, naturally produced an amazing radio, the remarkable value of which can be judged by the following features incorporated and by seeing it and hearing it at your dealers.

1. Completely shielded coils, condensers and wiring. 2. Acuminators for sharper tuning. 3. Completely balanced genuine neutrodyne. 4. Volume control. 5. Single tuning knob. 6. Illuminated dial. 7. Single cable outside connections. 8. Designed for easy installation in consoles. 9. Beautiful frosted brown crystalline finished cabinet.

AC model using new R.C.A. AC tubes and working directly from electric light socket through Crosley Power Converter is $65. Power Converter $60 extra.

Hear this wonderful new contribution to the enjoyment of radio. If you cannot find one of the 16,000 Crosley dealers near you, write Dept. 17 for his name and literature.

IMPROVED MUSICONES

Musicones improve the reception of any radio set. They are perfect affinities in finish, beauty and reproductive effectiveness for Crosley Radios. A tilt-table model, with brown mahogany finish stand 56 inches high, $27.50 — 16-inch Super-Musicone as pictured above with "Bandbox," $12.75— 19-inch Ultra-Musicone, $9.75.

Shielding is necessary in a modern radio receiver. The more sensitive the set is, the more you need it. Some sets are merely housed in a metal case.

This helps to keep strong local signals from breaking through, but it is even more important to keep them where they belong after you get them the proper way from the antenna.

A set has tubes, condensers and coils. Here is a coil. The lines around it are the magnetic field.

You know the earth's magnetic field will work a compass down in a mine, or up in a plane (it certainly worked for Lindbergh) and the fields around unshielded coils get all mixed up and the set howls and squeals and has to be choked off by turning down the filaments in the tubes.

Now if the coils are housed in copper shields the fields can't mess each other up, and the tubes can do a real job of amplifying. The coils in Crosley sets have these copper shields, and there isn't anything better.

Then there are the condensers, and if it wasn't for the shield around them, the fields would act like those in the coils, and the results would be just as bad, or worse.

It isn't enough to shield the coils and the condensers, because even the wiring of the set has fields around it. This too is shielded, as it is in all really high grade sets. Of course, it's all in knowing how to do it, but that's why Crosley sets can be as good as the best without costing half as much.

CONDENSERS PROPERLY HOUSED

APPROVED CONSOLES

Selected by Powel Crosley, Jr., as ideal, acoustically and mechanically for the installation of the Crosley "Bandbox" Genuine Musicone built in. Crosley dealers secure them from their jobbers through

H. T. ROBERTS CO. 914 S. Michigan Ave., Chicago, Ill.

Sales Agents for Approved Console Factories

Showers Brothers Company

The Wolf Mfg. Company

$35

$65

$85

NEUTRODYNE

CROSLEY RADIO

The Crosley Radio Corporation, Powel Crosley, Jr., Pres., Cincinnati, Ohio.

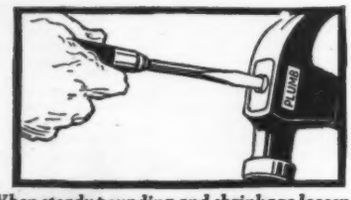
Crosley Radio is licensed only for Radio Amateur, Experimental and Broadcast Reception.

Prices slightly higher west of the Rocky Mountains

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

This unique invention solves the tool user's greatest problem

LOOSE handles! How often have you reached for your hammer and found that the head wobbled. Had to waste time trying to rewedge it. Then in a few days it was loose again.



When steady pounding and shrinkage loosen a Plumb Handle you just turn the Screw Wedge and it is tight again

Hundreds of wedges were invented to keep tool handles tight. But pounding . . . and shrinkage of the handle loosened them all.

So Plumb discarded old methods of wedging; experimented along entirely new lines.

—and developed a wedge that does away with loose handles for all time.

The Plumb Take-Up Wedge is designed, not to keep the handle tight, (no wedge does that), but to give you a ready means of retightening it.

Now . . . when hard work and shrinkage loosen a Plumb, you just turn the screw wedge and it is tight as new again.

Always safe! Always tight! Own a hammer like that. One you can grip and swing all day without tiring, so well is it balanced.

Drive husky nails or smallest brads with accuracy because the weight is placed just right in the head.

Pull headless nails; draw slim brads. The special "Plumb-bend" of the claws gives you powerful leverage. And the split of the claws grips anything.

The price of the HF 81, 1 lb. model is only $1.50. (Prices slightly higher in Far West and Canada.)

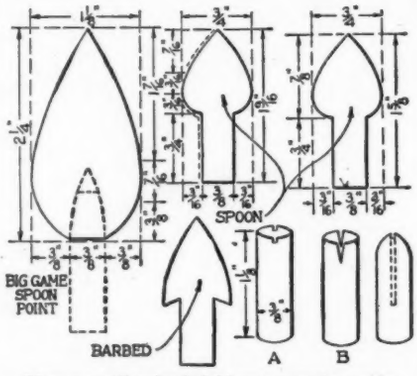
FAYETTE R. PLUMB, Inc.
Philadelphia, U. S. A.

Barbless Arrowheads Now Used for Hunting

By J. V. HAZZARD

UNSNAGGABLE, spoon-shaped arrowheads of the type illustrated have several advantages over the standard barbed points used for hunting. They do not catch in the brush while the bow is being drawn or at other critical moments; they do not cling so tenaciously when shot into roots or tangled grass; and they do not mar the shafts of other arrows when being removed from or returned to the quiver.

Arrowheads of small size for rabbits or other small game can be made in about



How a small point is laid out, sawed roughly to the approximate shape, and filed; a large point of the same type; and a ferrule or haft

twenty minutes. The blade is sawed and filed from 1/16 by 3/4 in. cold rolled steel. The haft, which is a piece of 5/16 or 3/8 in. brass tubing of from 25 to 27 gage, is sawmarked as at A and notched with a file as at B. The end of the wooden shaft is slotted, rounded, and tapered to a sharp Gothic arch. The tang of the blade is dropped into the haft with the base of the head resting in the saw marks, and the two pieces are forced on the slotted shaft. The fore end of the haft is then tapped or squeezed until it fits the rounded shaft head and blade closely, the long notches closing as it bends. After a liberal application of acid core solder and a little fairing up with a file, the point is ready.

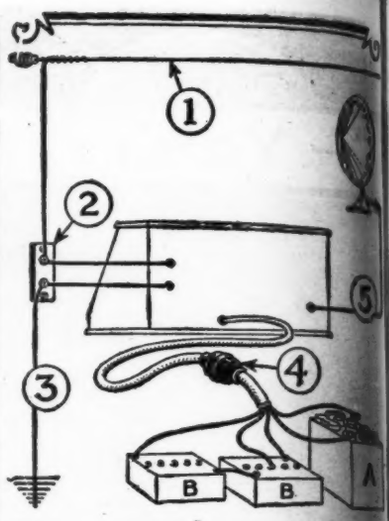
A working diagram for a big game point designed along the same lines is given, though it is recommended that 1/16-in. spring steel be used in place of the cold rolled steel mentioned above.

"B" Power for Old Set

(*Continued from page 78*)

winding of the bell-ringing transformer should be connected by a drop cord to an electric light socket. Use a double socket arrangement, so that when you turn off the eliminator, the bell-ringing transformer will be shut off at the same time.

If you desire information as to suitable parts to build this addition to the de luxe type eliminator, or in connection with adapting a factory built eliminator to an old style set, address your letters: Radio Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City. Be sure to give full details of your problem.



5 Important Accessories for Your Radio Set

1—Beldenamel Aerial Wire

Each strand protected by several coats of baked Beldenamel. Cannot corrode, even after long use. Maintains high set efficiency for range and volume.

2—Belden Lightning Arrester

A safeguard that is essential with every outdoor aerial. A high quality lightning arrester, approved by Fire Underwriters.

3—Belden Ground Wire

A special rubber-covered flexible conductor for lead-in and ground wires.

4—Belden Battery Cords

Furnished with or without A & B-battery fuses. Protects tubes and batteries. Improves appearance of set.

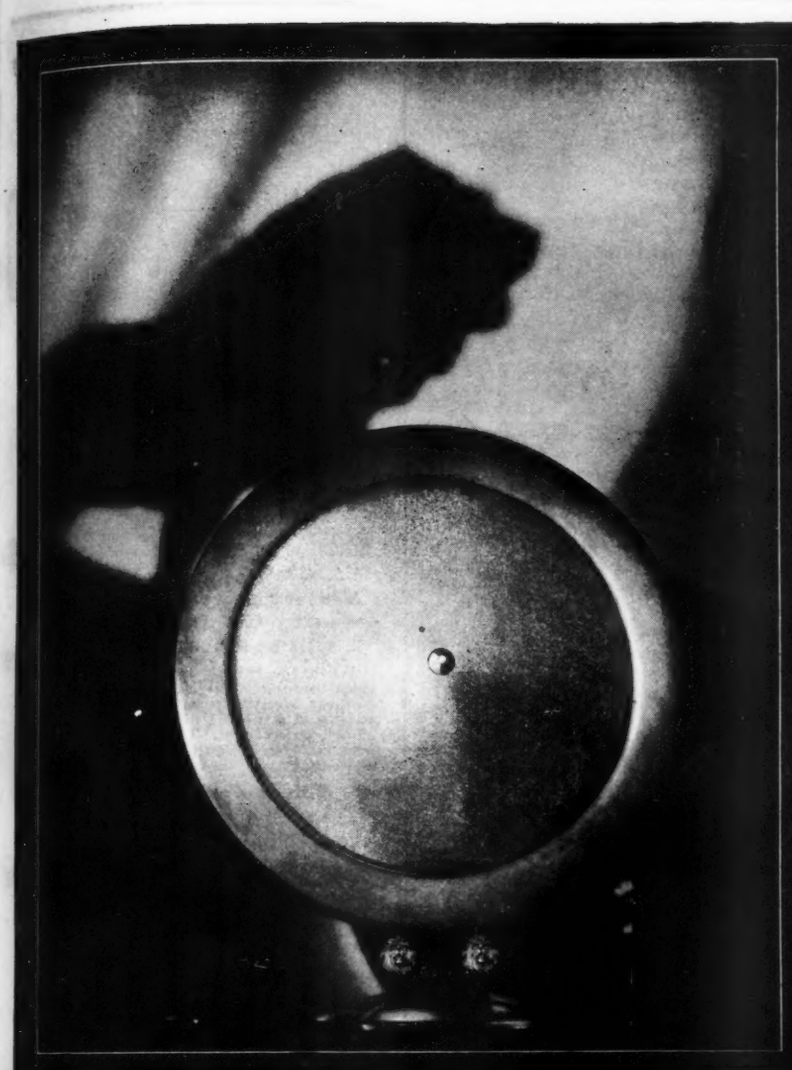
5—Belden Extension Cord

25-ft. extension cord for loudspeakers. Provided with connector. No tools required. Conductors are rubber-covered.

Belden Manufacturing Co.
2304a South Western Ave., Chicago, Ill.

Specify Belden
Radio Accessories

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



The LION

New Amplion Cone AC21. Price, $25.00. Height, including handsome bronze base, 22½".

The unit in the Cone is the new Amplion balanced armature type, non-adjustable, with straight bar magnets of the highest grade English tungsten steel.

The Lion combines a 14" Cone with an 18" Sound Board extended at the back towards the center forming a resonating chamber. This construction enables the Cone to reproduce with absolute fidelity all the notes—high and low—that your set detects.

How much is your radio set worth?

—not in terms of dollars, but in terms of loud speaker reproduction. That's the way to determine its value.

FOR proof of this, do not fail to have a demonstration of an Amplion—no matter what *set* you have or consider buying.

The Amplion line includes models from $12.00 to $145.00 —one for every radio reproduction requirement. Amplion prestige back of every model. Write for our descriptive literature.

THE AMPLION CORPORATION OF AMERICA

531-535 West 37th Street, New York

The Amplion Corporation of Canada, Ltd., Toronto, Ont.

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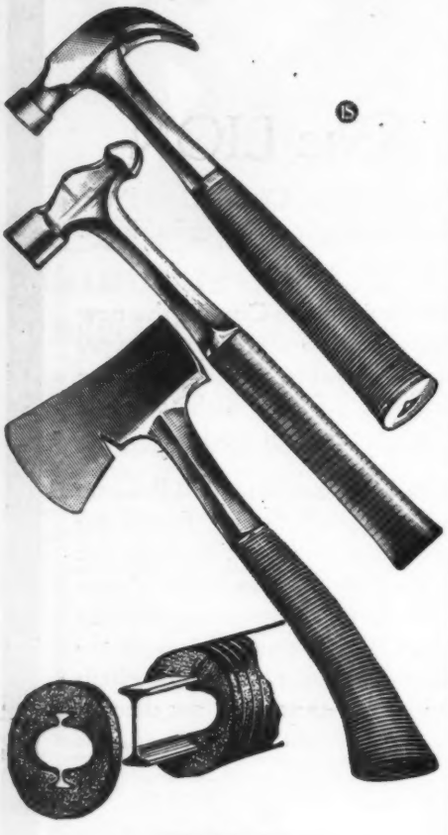
NEW



PROVEN UNBREAKABLE

and Superior in every way by 200,000 carpenters, machinists, National Industries etc. during 5 years.

Every tool carries a tag GUARANTEEING by FREE REPLACEMENT that the handle will

NEVER BREAK or LOOSEN

no matter how or how long used and that the edge, face and claw are unsurpassed.

They are FORGED head and handle, in one piece of fine Tool Steel, specially tempered. *The strongest material known.*
Grip is sole leather washers pressed on, riveted, weather proofed and polished. *The most comfortable material known.*

You will get the same satisfaction that is making all users boosters of these, the FIRST and ONLY patented tools Guaranteed "Unbreakable" and *Superior in every way.*

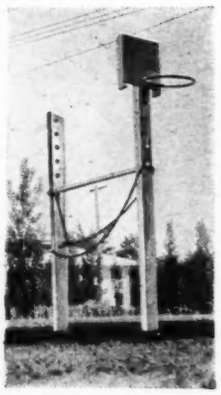
Using Estwing "Unbreakable" is Leadership

Show this to your dealer, he will be pleased to serve you. Or send money with order, inclose 15c extra for each tool ordered which pays postage; or pay mail man.

☐	Curved Claw Hammer, 12 oz. Head	$2.00
☐	" " " 16 " "	2.00
☐	" " " 20 " "	2.25
☐	Straight " " 12 " "	2.00
☐	" " " 16 " "	2.00
☐	" " " 20 " "	2.25
☐	Half Hatchet No. 2, Smooth Face	2.25
☐	" " Scored	2.25
☐	Util-ax 28 oz. with Leather Sheath	2.25
☐	Scout Ax. 24 oz. " " "	2.00
☐	Ball Pein Hammer, 16 oz. Head	1.75

ESTWING MFG CO., Rockford, Ill.

Simple Outdoor "Gym" Gives Boys Exercise



Horizontal bar and goal for basketball

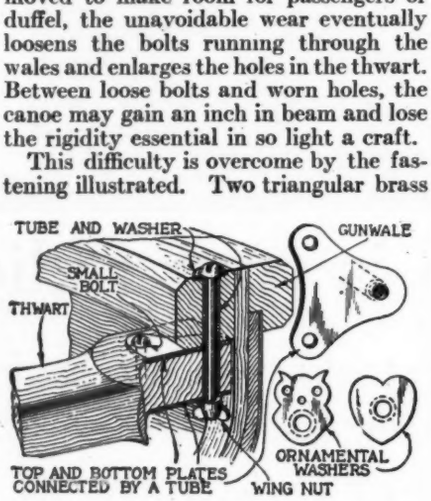
THE boys in a residential district of Topeka, Kansas, have many happy hours of wholesome exercise at the outdoor gymnasium illustrated.

The supports are 6 by 6 in. posts, standing 14 ft. high above the ground. They are set 4 ft. deep in cement and are spaced 6 ft apart. Six 2-in. holes are bored at intervals of 10 in. through the upper part of each post for the horizontal bar. A small back stop, made of 1-in. matched lumber and 2 by 4 in. crosspieces, is attached to one of the posts and carries a basketball goal for practicing purposes.—DALE R. VAN HORN.

Wear-Proof Thwart Fastening Improves Canvas Canoe

WHEN the center thwart of a canvas-covered canoe is frequently removed to make room for passengers or duffel, the unavoidable wear eventually loosens the bolts running through the wales and enlarges the holes in the thwart. Between loose bolts and worn holes, the canoe may gain an inch in beam and lose the rigidity essential in so light a craft.

This difficulty is overcome by the fastening illustrated. Two triangular brass



Cutaway view of thwart joint with brass-bushed holes; details of plates and washers

plates 1/32 in. thick are let into the thwart at each end and the hole between them is bushed with 5/8-in. brass tubing.

Another short piece of tubing with a washer soldered at one end is forced into a hole drilled along the course of the original hole in the wale. It is necessary, of course, to cut a recess in the wale so that the washer will fit down flush with the upper surface.

If a decorative touch is desired, the washers may be cut in ornamental shapes, two of which are suggested. Round-headed brass bolts, equal in diameter to the inside measurement of the tubing, and wing nuts complete the fastenings.

This improvement makes the thwart as solid as if it were permanent, yet it can be removed in a moment.—J. V. H.

Saved Again!

Size: 30" high; 32" long; 10" ins. wide.

Another great victory has been won by Old Ironsides and she will be saved for posterity

While the Frigate Constitution is in dry-dock undergoing rehabilitation the World's Largest Manufacturer of Ship Models has produced a model of the historic ship in knock-down form. The parts are cut-to-fit and ready-to-assemble. So simple is the plan that

You can put these models together in a few hours of pleasant pastime

You need not know anything about ship building to assemble one of these models. As a matter of fact if you have never seen a ship you can put the model of the Constitution together in a few hours by following our diagrams and instruction sheet which is so written that a school boy can understand it. All you need is a small hammer. The parts are numbered on the diagram to make the process even more simple. As long as you can understand such instructions as these (actually taken from assembling chart that is included with every model of the Constitution) you cannot fail: "Take No. 57, place it in front end of No. 56 and tap lightly with hammer. Next take No. 58 and place it up against No. 57 and tap with hammer to bring it into place."

Easy? Nothing simpler. The instructions are just like that from beginning to end. Do this and that—and before you realize it a beautiful model has grown before your eyes.

The model of the Constitution is exact in every detail. The hull, masts, spars, cannons, anchors and rigging correspond to those on the original ship in every way. After you have completed building one of our models from the $6.98 kit you will be as well satisfied that you would not take $50.00 or even $100.00 for the model.

Besides the model of the Constitution we manufacture parts for other historic ships. The Santa Maria and the Mayflower have been the most popular ship models ever built. We have sold these models to people in every part of the world and are shipping a large quantity of them daily to various parts of the United States, Europe, South America and even to Africa.

Send for our beautifully illustrated catalog which contains information and photographs of all our models. Fill in the coupon below today and send it to us and we will act upon it immediately.

MINIATURE SHIP MODELS
3818-20-22-24 Baring Street
Philadelphia, Pa.

MINIATURE SHIP MODELS, DEPT. 0
3818-20-22-24 Baring St., Phila., Pa.

Please send me the complete parts, cut to fit, and ready to assemble for the model Constitution. I will pay postman $6.98 plus postage (a few cents).

PLEASE PRINT NAME AND ADDRESS PLAINLY

Name .....

Street or R. F.D. .....

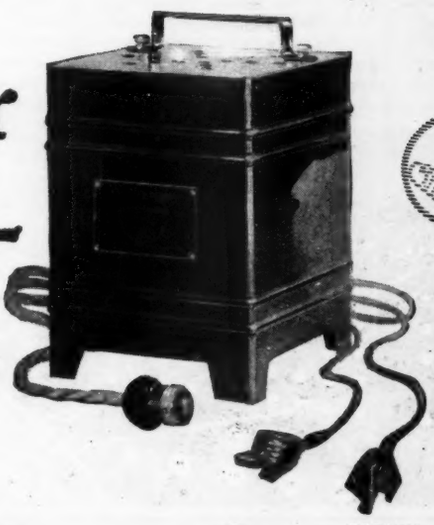
City .....

State .....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Trickle charge or full-rate charge—

You get either or both with



Westinghouse Rectigon Battery Charger

YOUR battery needs two kinds of charging!

Under ordinary conditions, a low-rate charge, "trickled in" during the hours that the set is idle, will keep the battery full of pep. Then, for occasions when prolonged use of the set drains more power than trickle chargers can replace, you need a high-rate charge. The Westinghouse Rectigon gives you ***both kinds of charging.*** Rectigon charges at a high rate and at a low rate—and it charges wet "B" as well as automobile batteries.

~~$18.00~~

Now

$14.00

Rectigon is a Westinghouse product—and you know Westinghouse knows radio. Back in 1920, the first program ever broadcast came from radio station KDKA. Rectigon is safe—uses no acids or chemicals. Long-lived, with no moving parts to break or wear out. Does no harm if you tune in while charging, nor if the light company turns off the power while Rectigon is in the circuit. Get away from charging station expense with Rectigon Home Charger. At your dealer's, now $14.00.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA.
Offices in All Principal Cities — Representatives Everywhere
Tune in with KDKA—KYW—WBZ

For trickle charging only—the long-lived little Rectox. No guesswork, no acids or chemicals, no trouble. Leave Rectox permanently on charge and replace during "silent hours" the power used during average "operating hours." Two rates of charge—½ ampere and ¾ ampere. At most dealers', $11.50.

See the Westinghouse exhibit of Rectigons, Radio Instruments, and Micarta Radio Panels at the Sixth Annual Radio Show, Coliseum, Chicago, October 10th to 16th, inclusive: Booth 1, Section AA.

W WESTINGHOUSE ELECTRIC

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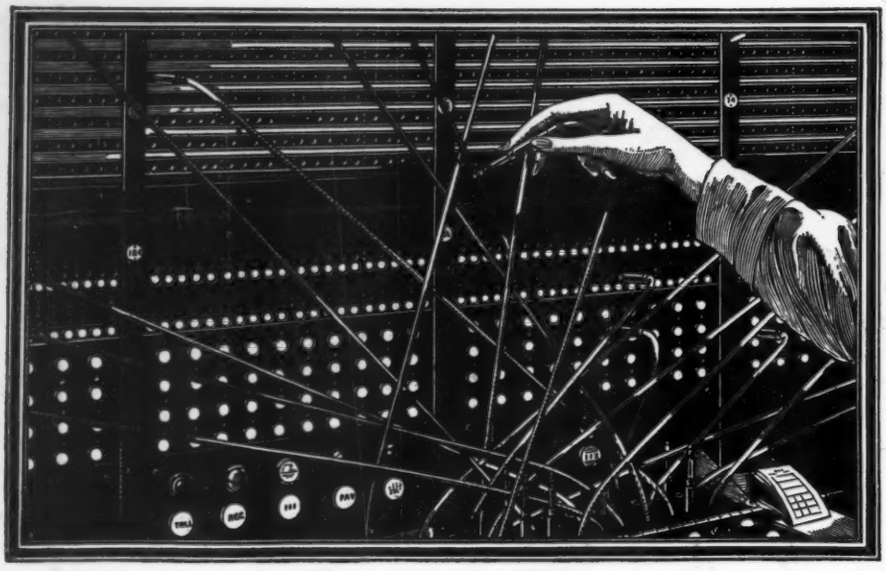


The Switchboard

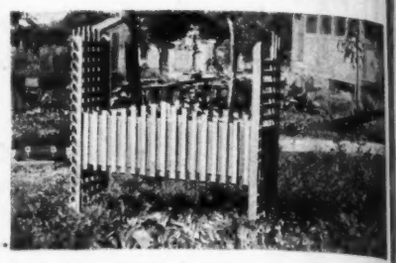
An Advertisement of
the American Telephone and Telegraph Company

A WEB of cords plugged into numbered holes. A hand ready to answer signals which flash from tiny lamps. A mind alert for prompt and accurate performance of a vital service. A devotion to duty inspired by a sense of the public's reliance on that service.

Every section of a telephone switchboard typifies the co-ordination of human effort and mechanism which makes possible America's far-reaching telephone service. Its cords link for instant speech those who are separated by a few miles or by a continent. Its guardian operators are of the telephone army—men and women vigilant to meet a nation's need for communications.

In plant and personnel, the Bell System is in effect a vast switchboard serving a nation that has been transformed into a neighborhood through telephone growth and development.

Lattice Strips Decorate Outdoor Flower Box

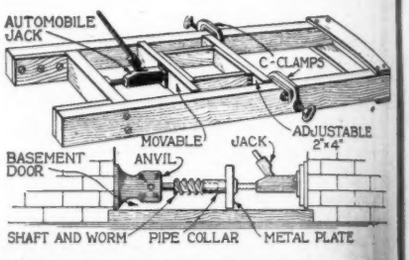


A plain wooden box dressed up with four corner pieces and left-over lattice strips

STRIPS of clear pine, left over from inclosing a back porch with lattice work, were used to ornament the outdoor flower box illustrated. The box itself was built of 12 in. wide boards; it is 3 ft. long and 12 in. wide. The four corner posts are 1 by 2 in. by 4 ft.—D. R. H.

Clamp for Gluing Furniture Made with Aid of a Jack

AN AUTO jack may be used as shown below for making a large adjustable clamp to aid in gluing furniture. The frame in which the work is placed varies, of course, according to the



Two shop uses for an old jack—in a clamp for gluing furniture and as an arbor press

size of the parts to be glued, but the arrangement in any size is adaptable to a wide variety of operations.

If you have a basement door with masonry walls on each side, you can also convert a screw or hydraulic jack into a powerful press. The arrangement illustrated is one that was used successfully for removing a bent steering gear shaft from the worm and pressing in a new shaft.

A little ingenuity will enable you to utilize a jack for many odd jobs of clamping, forcing and straightening.—WINSOR R. DAVIS.

Bench Plate for Riveting

MANY handy men occasionally have to do light riveting. To facilitate this in my own case, I have sunk a piece of hard steel ⅜ by 3 by 3 in. into the top of my workbench right over one of the front legs. Being flush with the top, the plate is out of the way, yet it makes a solid and useful anvil for small work.—P. J. KEENAN.

A WORN emery wheel can be dressed by holding against it while it revolves a number of small washers mounted on a large spike or bolt.—M. J. H.

This Wonder Engine at $55.00

is one of Hundreds of Bargains in our Complete Catalogue of Supplies and Materials such as Bearings, Belting, Blue Prints, Books on Scientific Subjects, Brass, Castings, Compressors, Gears, Lathes, Motors, Saws, Shafting, Rough Castings for Engines and Supplies for Model Makers and Handy Men.

Complete Catalogue 25 cents, which is allowed on first $2.00 order.

Amalgamated Sales and Service Corporation
327J South La Salle Street, Chicago, Illinois

PLUMBING-HEATING
Install Your Own—Save Half

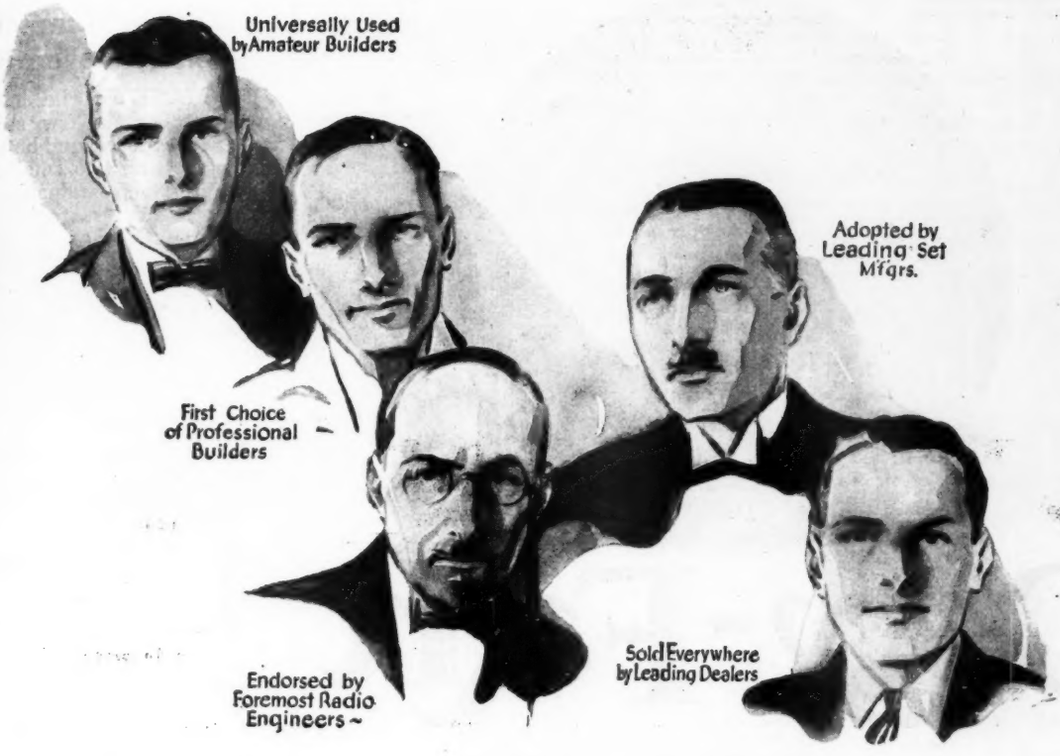
Lowest wholesale prices on highest quality Grade A goods. Any Handy Man can install his own Plumbing and Heating BY OUR NEW EASY METHOD. Get the best and pay only a little each month.

Send for FREE Book.

New bargain catalog just issued. With our cut-to-fit systems you save waste material and high labor cost. 50 years of economical service to home owners, farmers, builders and mechanics. Million Dollar Plants back up our Bonded Guarantee. FREE book gives you the whole story. Write for your copy today.

OVER 50 YRS. **HARDIN-LAVIN CO.** EST. 1876
106-16 West Pershing Road, Chicago, Ill.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.


Universally Used by Amateur Builders
Adopted by Leading Set Mfgrs.
First Choice of Professional Builders
Endorsed by Foremost Radio Engineers
Sold Everywhere by Leading Dealers

FIRST CHOICE of the Keenest Minds in Radio!

Durham standard resistors are made in ranges from 500 ohms to 10 megohms. Durham Powerohms for "B" Eliminators and Amplifier circuits are made in 2.5 watt and 5 watt sizes in ranges from 500 to 100,000 ohms.

Adopted by Leading Radio Manufacturers

Philco
Fansteel Products Co.
Kellogg-Switchboard
Western Electric
F. A. D. Andrea
Sterling Mfg. Co.
Kokomo Electric
Garod Radio Corp.
Browning-Drake
Howard Radio
A-C Dayton

FIRST CHOICE—because Durham was the first and original "metallized filament" resistor—because years of heavy production and the confidence of leading radio manufacturers have given us *time* to produce a perfect product.

Durham Resistors and Powerohms are the leaders in their field because their uniform, unfailing accuracy and absolute reliability have been proved time and time again.

This is why they are the first choice of foremost engineers, leading manufacturers, professional set builders and informed radio fans who demand quality results.

Like Durham Resistors and Powerohms, Durham Resistor Mountings are also the leaders in their field. The only upright mountings made; takes minimum space—made of high resistance moulded insulation—best quality tension-spring bronze contacts. Single and double sizes.

DURHAM METALLIZED

RESISTORS & POWEROHMS

INTERNATIONAL RESISTANCE CO., Dept. T, 2½ South 20th Street, Philadelphia, Pa.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Day-Fan

means

Battery Elimination
by the Newest Methods

Glorious Tone
throughout the whole Scale

and All 'Round Radio Satisfaction

If it's battery elimination that interests you this year, remember that Day-Fan is making radio history in this direction. The Day-Fan line includes sets which operate direct from the light socket, either through AC tubes, or through Day-Fan's new invention, radio power by means of a tiny motor and a powerful little generator.

If you want a low priced set, the Day-Fan line includes the Day-Fan Junior, retailing at $65, but still possessing the magnificent and characteristic Day-Fan tone.

If you want battery operated sets, the Day-Fan line includes them, too.

Of course you want tone quality—the one single and most important necessity for your radio enjoyment. The Day-Fan tone is so famous that this radio receiver is used by great broadcasting stations to listen to their own programs. Once you hear a Day-Fan you will never be satisfied with the sound of any other radio. All Day-Fan dealers are glad to have you listen to Day-Fan sets.

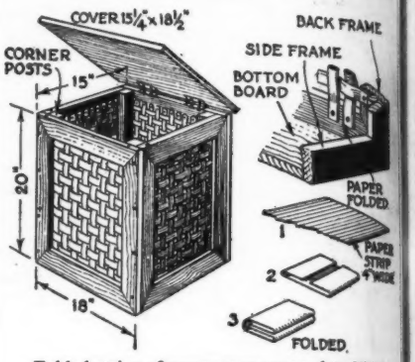
Before you buy this year, before you bring your radio enjoyment up to date with one of the fine new sets, write us and let us give you full particulars about the Day-Fan Radio line. Just drop a postcard to the address below, and our circular showing you the entire line will be sent you by return mail.

Day-Fan Electric Co., Dept. P. S. 2, Dayton, Ohio

Clothes Hamper Made with Woven Paper

TO MAKE a clothes hamper like that illustrated, a few strips of wood, a board for the top and bottom, a number of newspapers, two small hinges, a can of paint, glue, sandpaper, nails, tacks, and corrugated fasteners are required.

The builder may determine the dimensions to suit himself, but those indicated give a hamper of convenient size. Strips ½ by 1½ in. are mitered to make the frames. The pieces for each frame are laid face down on the floor, glued and fastened with ¼-in. corrugated fasteners.



Folded strips of newspaper are used to fill in the frames of this light, basketlike hamper

A sixpenny nail is then driven into each joint from the edge to strengthen it further.

The front and back and two side frames may be exactly alike, although I took the trouble to make one upright member of each of the side frames ½ by 1 in., so that when the front was nailed on, the total width at the corner would appear to be 1½ in. The back frame was made 17 in. wide instead of 18, and nailed between the side frames. It is simpler, however, to make two pairs of similar frames.

When the frames were ready, a number of 4 in. wide strips of newspaper were cut and folded as shown. These were tacked across each frame with ¼-in. spaces between, and similar pieces were woven over and under in the opposite direction. Cleats may be nailed or screwed over the ends of the paper to protect them.

The hamper was assembled, the paper given a coat of thin shellac, and the whole finished with three coats of paint inside and outside.—W. W. Last.

Novelty Finishes for Woodwork

WOODWORK and trim in small rooms is sometimes given a novel stippled finish with two or three coats of flat paint or brushing lacquer and a very thin glazing coat of a harmonizing or contrasting color. Glazing colors can be purchased for use over flat paints, and a glaze for use over lacquers can be made simply by thinning a lacquer of the selected color with lacquer thinner made by the same manufacturer. The thin color is stippled on with a large stencil brush, which must be wiped frequently to keep it reasonably dry. Color combinations range from a raw sienna glaze over an ivory groundwork to such novelties as silver undercoats with dark blue glaze and venetian red with brown-mahogany.

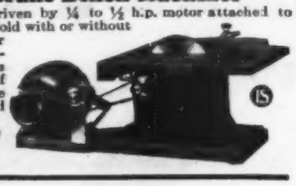
Make More Money Read the Money Making Opportunities on pages 150 to 182 of this Issue.

Round Out Your Shop!

Complete your home workshop with a Boice-Crane Bench Saw. Cost is small, requires little power and lasts a lifetime. Practical, speedy and remarkably accurate. No matter what else you want—jointer, mortiser, band saw, circular saw, lathe, drill—you'll find it in the line of

Boice-Crane Bench Machines

All portable and driven by ¼ to ½ h.p. motor attached to any light socket. Sold with or without motor. Send 10c for fully illustrated catalog. Also contains other information of interest to home shop owners. Send today!



W.E. & J.E. Boice
Dept. P.S. 10-C
Toledo, Ohio

RADIO AT WHOLESALE
Write for my Big 1928 Radio Catalog —just off the press. Thousands of marvelous bargains in nationally advertised goods. All the LATEST IN RADIOS and equipment. Lowest wholesale prices.
It's a regular encyclopedia on Radio. All about trouble finding.
FREE Log and Call Book and Catalog. Get your copy today. Send postcard now!
Agents Wanted.
FREE
DEALERS NEW 1928 CATALOG
American Auto & Radio Mfg. Co.
HARRY SCHWARTZBERG, PRES.
Dept. 283 American Radio Bldg., Kansas City, Mo. 3

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

And Now—

the "A" Socket Power *that is as "dry as a bone"!*

HOOK up this new Sterling Dri-A to the set, plug in the light socket, adjust it *once* for correct voltage · · and forget it. No liquids or water to add, ever · · no attention · · no bulbs · · *nothing!* The meter adjustment takes care of fluctuations in line voltage and assures 6 good volts *all the time.*

The recently developed high capacity Sterling dry condensers plus the remarkably efficient, unbreakable Raytheon "A" Rectifier cartridge makes this unit the last word in "A" Socket-Power units.

Sterling Dri-A is smaller than your storage "A" Battery, yet it provides "A" Power for as many as 12 tubes. It provides complete control of "A" current, "B" Power or batteries and reception from single switch without turning off the house current. And costs · · complete with one Raytheon "A" cartridge · · · · · · · **$32.50**

Ask your dealer for a demonstration.

Extra Raytheon "A" Rectifier for use with more than 6 tubes **$4.50**

Sterling Dri-A

Socket Power

THE STERLING MFG. COMPANY
2831 Prospect Avenue · · Cleveland, Ohio

What the names Sterling and Raytheon mean to the set-owner

EARLY in the history of popular radio it was realized that the electrically operated radio set must come. In the ideal light socket power, simplicity, silence and continuity of operation must be assured with freedom, of course, from professional servicing. Furthermore, the one unit must be capable of being used on a large variety of sets in order to keep pace with rapid developments and changes in the construction of radio receivers. Here were new problems for the electrical industry to tackle.

At first the demand for socket power units led many inexperienced concerns to embark on the manufacture of socket power units, the result being that for a time the market was flooded with many unsatisfactory instruments. In the meantime, two firms, with their background of electrical experience, stepped into the field. The Sterling Manufacturing Company of Cleveland, with a record of millions of electric and radio devices since 1906 and the Raytheon Manufacturing Co., of Cambridge, Mass., who after years of research perfected their now famous Raytheon BH Rectifying tube—the tube that has made the "B" eliminator a success.

Raytheon BH Tube

It is this tube that has proved beyond question its ability to deliver and maintain its voltage. Just recently its rating was increased to deliver 300 volts at 125 mils.

Raytheon has always insisted on standards of quality and design that would enable its tube to function always at its best. For the protection of the public as much as for their own only manufacturers of power units which have passed rigid tests in Raytheon's laboratories are entitled to use the Raytheon "Seal of Approval."

DESIGNED FOR USE WITH Raytheon TYPE B H LONG LIFE RECTIFYING TUBE

Raytheon "Seal of Approval"

From the start Sterling engineers have worked with Raytheon. Together they have produced units in which both tube and power unit function to the best possible advantage of the user and give most accurate power regulation and longest life to the tube.

Do not confuse a unit merely *using* the Raytheon BH tube with a unit bearing Raytheon's "Seal of Approval."

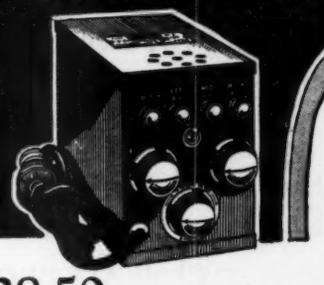
Another Raytheon development also utilized by Sterling in its wide range of "A" Socket Powers and "A" Battery Chargers is the Raytheon "A" Rectifier. No larger than the first finger, this rectifier is metal encased, absolutely unbreakable, and completely replaces bulbs, and similar devices which generate excessive heat. Silent and long lasting, it provides the solution to "A" Battery elimination problems.

Raytheon "A" Rectifier

To own a Sterling Raytheon-equipped socket unit is to be assured of unfailing performance and trouble free operation—the "nth degree of radio satisfaction."

ADVERTISING

More *for your money in this* $28.50 Sterling "B" Power Unit



$28.50 is an amazingly low price for this Sterling-built, *Raytheon-approved* "B" Power Unit.

For efficiency, for permanent operation, only the *genuine* Raytheon BH Tube is used. For convenience there's an "on" and "off" switch.

Exact Regulation

The Sterling method of voltage regulation for each stage enables you to build up the voltage for eight tubes [including power tube] or to reduce it to the exact amount for three tubes—without overloading. Sterling perfected power regulation insures the utmost in volume and tone.

Ask your dealer for a demonstration

THE STERLING MFG. CO.
2831-53 Prospect Ave. · Cleveland, Ohio

DESIGNED FOR USE WITH Raytheon TYPE B H LONG LIFE RECTIFYING TUBE

The Sterling Mfg. Co.'s 21-year reputation stands behind every dealer who sells the Sterling line.

Perfect current Regulation for your set

Genuine Raytheon B H Equipped

Ask the Old-Timers about

STAR HACK SAWS

They all know Star Hack Saw blades as they have used these blades for more than one-half a century.

There is not a country on the globe where Star blades are not known to the oldest, and most skilled mechanics to be a good and efficient blade.

When you have a difficult cutting job to do tell us of your problem and let us send you a FREE sample blade that will do the job.

Send for chart.

Clemson Brothers, Inc.
Middletown, N. Y.

MAKERS SINCE 1883

STAR HACK SAWS

Blueprints for Your Home Workshop

Nos. 2 and 15

ANY ONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine, in which the project was described in detail, it can be had for 25 cents additional so long as copies are available.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....dollars.....cents:

No.	Title	Described in Issues of	Price
1.	Sewing Table	Feb., '22	25c
2.	Smoking Cabinet	Mar., '22	25c
3.	End Table	Apr., '22	25c
5.	Kitchen Cabinet	May, '22	25c
8.	Shaving Cabinet	June, '22	25c
9.	Arbor, Gate and Seats	July, '22	25c
10.	Porch Swing	Aug., '22	25c
11.	Bench and Tilt Table	Sept., '22	25c
12.	Electric Washer	Oct., '22	25c
13.	Tea Wagon	Nov., '22	25c
14.	Christmas Toys	Dec., '22	25c
15.	Workshop Bench	Jan., '23	25c
16.	Inlaid Radio Cabinet	Feb., '23	25c
17.	Cedar Chest	Mar., '23	25c
18.	Phone Table and Stool	Mar., '23	25c
19.	Grandfather's Clock	Apr., '23	25c
20.	Flat Top Desk	Apr., '23	25c
21.	Colonial Desk	Apr., '23	25c
22.	Cabinet and Desk	Apr., '23	25c
23.	Pergola Garage	May, '23	25c
24.	Gateleg Table	June, '23	25c
25.	Canoe Sailing Outfit	July, '23	25c
26.	Baby's Crib and Pen	Sept., '23	25c
27.	Kitchen-Cabinet Table	Oct., '23	25c
28.	Pullman Play Table	Nov., '23	25c
29.	Toy Tea Cart, etc.	Dec., '23	25c
30.	Tool Cabinet, etc.	Jan., '24	25c
31.	Sewing Cabinets	Feb., '24	25c
32.	Chinese Game Table	Mar., '24	25c
33.	Dining Alcove	Apr., '24	25c
34.	Garden Trellises	May, '24	25c
35.	Simple Radio Cabinet	Oct., '24	25c
36.	Rush-Bottom Chair	Nov., '24	25c
37.	Simplified Bookcase	Dec., '24	25c
38.	Sheraton Table	Jan., '25	25c
39.	Salem Chest	Feb., '25	25c
40.	Desk in Sheraton Style	Mar., '25	25c
41.	One-Tube Radio Set	May, '25	25c
42.	Three-Stage Amplifier	June, '25	25c
43.	Four-Tube Receiver	July, '25	25c
44.	Pirate Ship Model—Hull	Feb., '26	25c
45.	Pirate Ship—Details	Mar., '26	25c
46.	Galleon Model—Hull	May, '26	25c
47.	Galleon Model—Details	June, '26	25c
48.	Sailing Yacht Model	July, '26	25c
49.	Broom Cabinet	Aug., '26	25c
50.	Airplane Model (Flying)	Sept., '26	25c
51.	Clipper Ship Model—Hull	Oct., '26	25c
52.	Clipper Model—Details	Oct., '26	25c
53.	Clipper Model—Rigging	Nov., '26	25c
54.	Five-Tube Radio Set	Oct., '26	25c
55.	Five-Tube Set—Details	Oct., '26	25c
56.	Bird and Animal Toys	Dec., '26	25c
57.	*Constitution* Model—Hull	Jan., '27	25c
58.	*Constitution*—Rigging	Feb., '27	25c
59.	*Constitution*—Rigging	Mar., '27	25c
60.	Welsh Dresser	Mar., '27	25c
61.	Viking Ship Model—Hull	Apr., '27	25c
62.	Viking Ship—Details	Apr., '27	25c
63.	Toy Motor Boat—Hull	May, '27	25c
64.	Toy Motor Boat—Details	May, '27	25c
65.	Six Simple Block Puzzles	June, '27	25c
66.	Ship-Model Weather Vane	Aug., '27	25c
67.	Toy Model of Lindbergh's New York-to-Paris Plane	Aug., '27	25c
68.	Magazine-Rack Table and Book-Trough Table	Sept., '27	25c
69.	Flying Model (3 ft.) of Lindbergh's Monoplane	Oct., '27	25c

Name.....
(Please print name and address very clearly)

Street.....

City and State.....

On The Lookout for Lost Motion

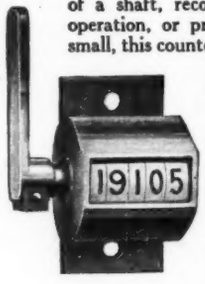
In developing *or* in operating machines, you pay for production—not motion.

Production-*results* are all that count on the dial of a Veeder Counter. Lost motion in development work—lost motion in machine-operator's work—register zero.

You've a check-up on unworkable ideas and "unworking" operators in the *work-records of*

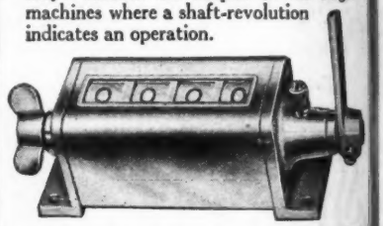
Veeder COUNTERS

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines and most adaptable to experimental work. If run backward the counter subtracts. Price $2.00. (*Cut 4/5 size.*)



Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00.

The Revolution Set-Back Counter below records the output of the larger machines where a shaft-revolution indicates an operation.



Sets back to zero from any figure by turning knob once around. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50.

The Veeder booklet shows instruments that "count everything on earth." See them—by sending for the book.

The Veeder Mfg. Co.
44 Sargeant St. Hartford, Conn.

When you have decided to use house current for your receiver-

..what Power Unit will you buy?

A battery eliminator isn't one of those things you can just look at and say it's good or bad. Nor can you determine its qualities with a few moments' trial. How then, can you be assured of a reliable unit of lasting satisfaction? Over 700,000 satisfied users of light socket power units will tell you to be sure it is Raytheon *approved* and equipped with the Raytheon long life rectifying tube.

You can identify a Raytheon type power unit by the green *Seal of Approval* on the front. Only units that have been tested and approved can use this symbol or the Raytheon gaseous type tube.

Our Technical Service Department will be glad to answer questions or send the latest Radio Power Bulletin covering in detail any subject on light socket power in which you may be interested.

RAYTHEON MANUFACTURING CO., Cambridge, Mass.

Type B
60 m.a. 150 volts

Type BH
125 m.a. 300 volts

Raytheon

THE HEART OF RELIABLE RADIO POWER

Type A
2½ Amps.

Type BA
A-B-C power
350 m.a.

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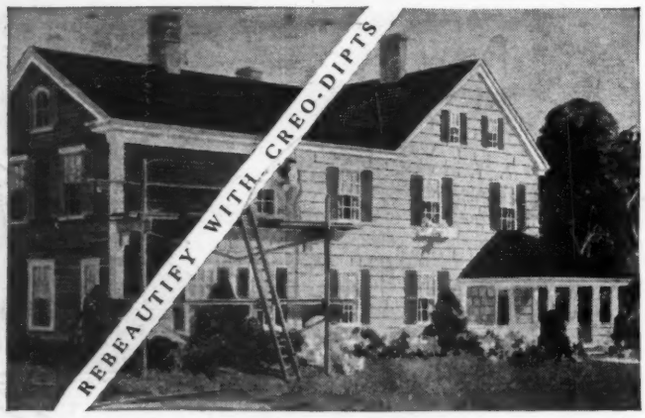
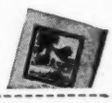


Save fuel . . . save paint

INSTEAD of re-painting, lay Creo-Dipt Stained Shingles right over old side-walls . . . and cut your annual fuel bill from 15% to 25%. Reduce paint bills, too. In 5 to 7 years Creo-Dipt side-walls save enough paint to pay for themselves.

Find out about these amazing Creo-Dipt savings. Mail the coupon now. Ask about Creo-Dipts—not only for covering old side-walls, but for re-roofing, or for roof and sides of new homes. Or, see your lumber dealer . . . leading lumber dealers everywhere carry genuine Creo-Dipts in stock. Look for the name on each bundle.

CREO-DIPT
Stained Shingles



Creo-Dipt Co., Inc., 123 Oliver St., No. Tonawanda, N. Y. (In Canada: Creo-Dipt Co., Ltd., 1610 Royal Bank Bldg., Toronto.) Sales offices in principal cities.
Enclosed find 25c for portfolio of large-size photographs of Creo-Dipt homes, booklet of color suggestions, and name of local Creo-Dipt dealer.

Check the use that interests you

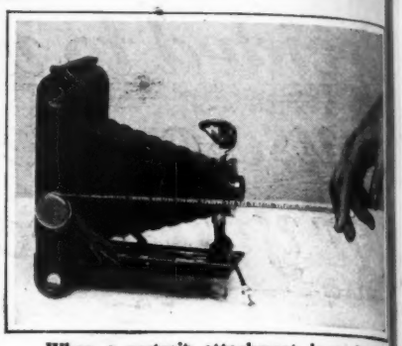
☐ Covering old side-walls ☐ New roof
☐ Building new ☐ Re-roofing

Name.....

Address.....

Tape Is Aid in Taking Photographic Portraits

BY USING a dressmaker's small spring tape measure, the amateur photographer can always be sure he has the correct distance when he is taking pictures with a portrait attachment. Many photographers use a string, knotted at given



When a portrait attachment is used, a small tape measure gives the focus exactly

intervals, but with a tape measure the exact distance can always be found.

The case is soldered to a 3/16-in. bolt, ½ in. long, by means of which it is fastened in the tapped hole that is already in the camera for receiving the tripod screw.—WILLIAM M. WAILES, JR.

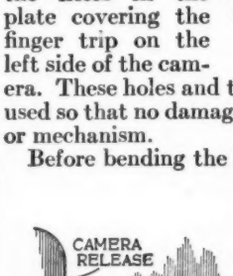
Using an Automatic Timer with a Graflex Camera

THE owner of a graflex camera sometimes wishes to take group pictures with himself included. For this purpose an automatic timer intended for kodaks may be used, if a simple attachment is made of 1/16 in. thick sheet brass as shown, and fastened to the camera.

The timer attached to a special lever

The main plate is first cut to shape and holes are drilled to correspond with the holes in the plate covering the finger trip on the left side of the camera. These holes and the same screws are used so that no damage is done to camera or mechanism.

Before bending the brass, anneal it by heating to a red heat and plunging it in cold water. The pivot screw has a shoulder of a trifle more than ½ in., but if such a screw is not to be obtained, an ordinary screw may be put in just far enough to prevent binding and then riveted in the back, flush with the plate. The lip in the main plate is drilled and tapped to suit the timing device.—GEORGE BENDER.



How the lever and main plate are made

New!

No More Socket Trouble

A socket's only job is to provide a perfect contact. The New Eby Socket has a 3 point wiping spring contact the full length of the prong, the most scientifically perfect type known. The prongs are completely enclosed and fit snugly against the phenolic walls of the socket—**they can't spread.**

With the New Eby Socket your socket troubles are gone. Easy to mount above or below Bakelite, Wood or Metal.

Specified in most of the leading popular circuits.

List Price 40c

THE H. H. EBY MFG. CO.
INCORPORATED
4710 Stenton Ave.
Phila., Pa.

Makers of Eby Binding Posts

It soothes as it smooths as it gleans

Barbasol takes all the trouble out of shaving—all the pull and sting and smart. No brush. No rub-in. Use Barbasol—3 times—according to directions.

"Mister, you're next!"

Barbasol
For Modern Shaving

The Barbasol Company
Indianapolis, Ind.

I enclose 10c. Please send trial tube.

Name.....

Address.....

P-S-M-10-27

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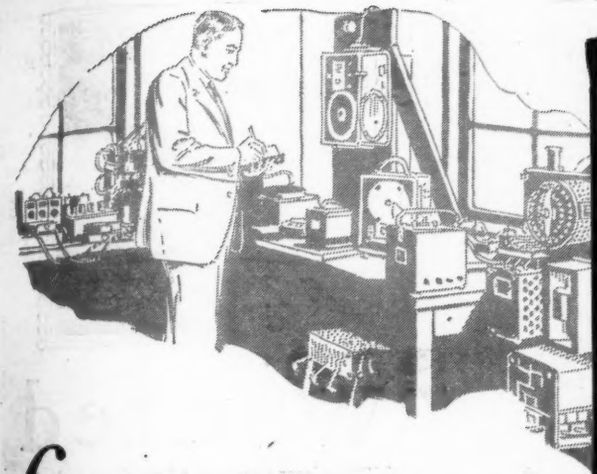


CABINETS BY CASWELL-RUNYAN

Combined Genius of the World's greatest inventors makes possible this marvelous New Electric Radio Receiver

THE Freed-Eisemann 1927 *electric* set is made possible by the combined genius of the world's greatest inventors and electrical engineers.

The application of the tuned radio frequency principle—the development of Ernst Fredrick Werner Alexanderson of the General Electric Laboratories, makes possible the marked ability of this set to sharply separate all stations.

The use of the Neutrodyne Principle invented by Professor Louis Alan Hazeltine when Professor of Electric Engineering at Stevens Institute of Technology makes possible the high amplification without regeneration.

To insure perfection of tone and simplicity of operation there has been used in this electric receiver the inventions of Dr. Irving Langmuir of the General Electric Laboratories, A. McL. Nichols of the Western Electric Company, Dr. Lee DeForest, Dr. S. Loewe of the Telefunken Company, Berlin, Germany, and of L. W. Chubb of the Westinghouse Electric and Manufacturing Company and several other distinguished electric and radio research engineers.

Included in this set are the basic principles covered by the patents of Professor Marius C. A. Latour, the noted French electro-physicist whose invention has been used extensively by Le Material Telephonique—the French telephone company.

Thus, actually the combined genius of the world's great radio engineers has made possible in this receiver not only simplicity of operation but also the ability to bring to your home the programs of all stations faithfully reproduced in full beautiful tones.

Operated from Light Socket

The Freed-Eisemann *electric* set answers the long felt need for a radio set that could be plugged into the light socket—there are no batteries or other attachments that need constant care.

Do not be confused. There are many "electrified" sets—that is, sets that in one form or another use battery power units. The new set developed in the laboratories of Freed-Eisemann is not an electrified set. It is an *electric* set in the true sense of the word. The power you have in your electric light wires runs the set.

Designed Right and Manufactured to a Standard

Freed-Eisemann was one of the early builders of Radio Receivers. Every set manufactured has been built with up-to-the-minute engineering practice. We can say, without qualification, that this 1927 Electric 11 Receiver is not only the finest in engineering design but the best in precision of manufacture that we have ever produced. This set has been made possible by the inventions of the world's greatest engineers.

Programs You Will Not Want to Miss

There are many things scheduled to be broadcast beginning September 1 that you will not want to miss, for instance, the Tunney-Dempsey Fight . . . the World Series . . . the College Football Games . . . Opera Stars . . . Famous Comedians . . . and Fine Sermons. The programs that are scheduled for the next few months are the finest that have ever been presented by radio. Don't miss them. Have your dealer demonstrate for you today the Freed-Eisemann *Electric* 11 Set and be prepared for the coming feature programs—

Amazing Low Price

Because of the advance orders placed by our dealers when we demonstrated to them this marvelous receiver, we have been able to manufacture on a volume basis that has cut the cost of production to a point where the *Electric* 11 Receiver can be sold at a price within the reach of everyone. The Freed-Eisemann dealer in your town is a trained radio man. He will gladly demonstrate the marvelous *Electric* 11 Receiver and tell you about the Budget Payment Plan through which you can have this set in your home NOW.

Select Your Set Now

The demand for these Modern Receivers is already beyond our capacity to produce them and it is essential that you act at once if you are to have this great Receiver in your home.

FREED-EISEMANN RADIO

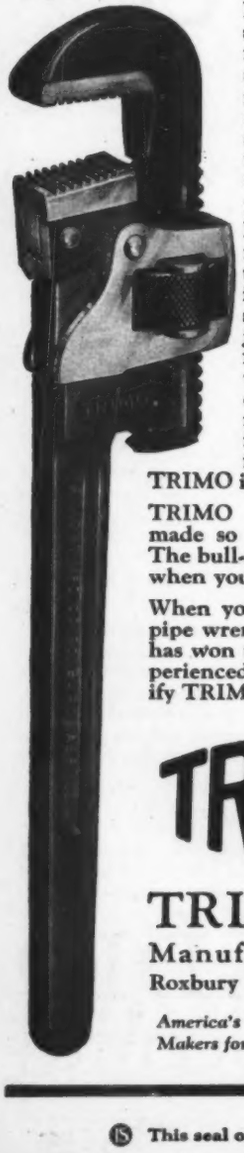
Brooklyn THE RADIO OF AMERICA'S FINEST HOMES New York

Licensed under patents of Latour, Hazeltine, and Radio Corp. of America

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

"Give Me A Pipe Wrench"

The man who doesn't bother to specify what kind of a pipe wrench he wants doesn't deserve much sympathy if he gets a poor one.



It's a different story with the man who knows something about good tools. He specifies TRIMO and gets something for his money.

For a TRIMO Pipe Wrench not only saves time and temper; it is a real money saver. Those jaws that grip so firmly may wear dull—someday. If they do, new ones can be inserted at trifling cost, and TRIMO is as good as ever.

TRIMO wrenches are made so they can't lock. The bull-dog grip lets go—when you want it to.

When you buy your next pipe wrench, get one that has won the loyalty of experienced tool users. Specify TRIMO.

TRIMO

TRIMONT Manufacturing Co.
Roxbury (Boston), Mass.

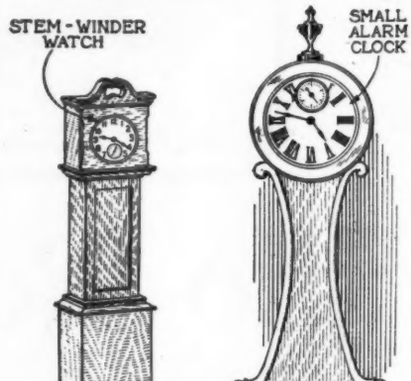
America's Leading Wrench Makers for nearly Forty Years

Miniature Clocks Are Easy to Build

By W. P. Craig

MINIATURE grandfather and banjo clocks are decorative and useful little novelties. A watch, small alarm clock, or desk clock will serve for the "works" and the case can be constructed to suit. Two designs are illustrated, and many variations are possible.

An old key-wind watch, which can often be found among the family heirlooms or else purchased cheaply in a pawnshop, is excellent for this purpose. The case can be of almost any kind of wood, preferably mahogany or walnut. If white pine, whitewood, or any other light colored wood is used, the finish may be cherry red brushing lacquer or mahogany or walnut colored varnish stain.



Decorative cases such as these can be made to receive old watches or small clocks

The amount of carving and molding to be used depends entirely upon the skill of the builder. The paneling can be recessed with carving tools or else indicated in dark lines after painting or staining.

The hole bored for the watch or clock with an expansive bit should be a reasonably tight fit. The watch ring or clock ring and feet should be removed. In the case of a watch, it will be necessary to cut a slot in the wood at the rear of the case to receive the stem. A small pin may be bent into a staple and driven into the wood to hold the stem from shifting.

Why Do Some Saws Have "Nibs"?

AMATEUR mechanics often wonder why some hand saws have a nib on the back near the point. One explanation is that carpenters of the old school used to fasten a piece of slotted wood over the teeth of the saw to protect them from damage while being carried from job to job. Two strings were used to hold the strip in place, and the purpose of the nib was to keep the string over the point from slipping off.

Wanted

MEN to learn to play the Saxophone and other band instruments, and fit themselves for high salaried positions, most enjoyable work, short hours, ideal environment.

No special talent required. Anyone who can whistle a tune and keep step with a march can quickly master any Buescher True Tone Instrument. Many learn scales in an hour, play tunes the first week. You can.

Buescher Assures Success

But only with a Buescher is this rapid progress assured. Perfect tuning, easy natural blowing, simplified fingering, give special advantages.

Easy to Play, Easy to Pay

Take any Buescher Instrument home for 6 days' trial. Pay for it by the month. Earn as you learn. Play as you pay. Satisfaction guaranteed. Send coupon for beautiful catalog. Mention favorite instrument. A big job awaits you. Don't delay.

BUESCHER BAND INSTRUMENT CO.
Everything in Band and Orchestra Instruments
2118 Buescher Block Elkhart, Indiana

Buescher easy playing Trumpets and Trombones are the choice of the world's leading artists. Mail coupon for special catalog of your favorite instrument.

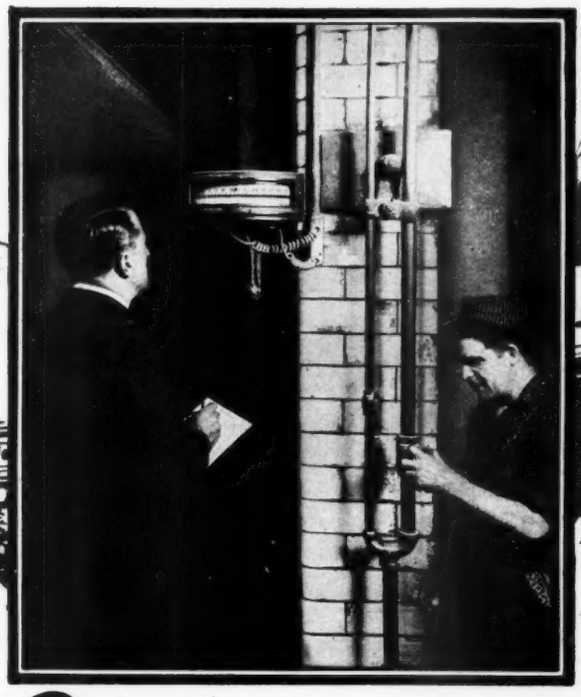
BUESCHER True Tone
Band and Orchestra INSTRUMENTS

BUESCHER BAND INSTRUMENT CO., 368A
2118 Buescher Block, Elkhart, Ind.
Gentlemen: Without obligating me in any way please send me your free literature. I am interested in the instrument checked here. Saxophone ☐ Cornet ☐ Trumpet ☐ Trombone ☐ Tuba ☐ Mention any other.....
Age?.... What instrument, if any, do you play?....
Name.....
Address.....
City.....State.....

Write Like a Business Man

Own a standard *remanufactured* typewriter—Underwood, Royal, L. C. Smith, Remington—*at saving of 40 to 60%*. Looks like new. Runs like new. *5 year guarantee.* Instruction in rapid touch typing free to purchaser. Express prepaid. EZ terms. 10 days' free trial.
Write today for Free catalog of typewriter bargains
Young Typewriter Co. 654 W. Randolph
Typewriter Headquarters. Dept. 142-A, Chicago

A 2c Stamp
—will start you on the road to success. See Money Making Opportunities on pages 150 to 182.



The heating of Office Buildings is controlled by Tycos

EVERY owner of an office building, plant, apartment house or hotel can cut down his bill for fuel by installing *Tycos* Temperature Instruments in his boiler room.

The Chief Engineer of the Metropolitan Life Insurance Company uses a *Taylor* Recording Pyrometer to record furnace and stack temperatures. It insures highest efficiency by keeping furnace temperatures more even—and if the stack temperature rises he can detect and stop at once loss from this inefficiency. Other *Tycos* Instruments are used to measure drafts to show whether or not too many boilers are being used at night. And still another *Tycos* Instrument is used to maintain 140 degrees on the hot water heater. Maintaining this even temperature eliminates possible accidents to tenants from too hot water or "kicks" of no hot water.

By using *Tycos* Instruments this Chief Engineer increases the whole efficiency of his heating plant—*and cuts down his fuel bill.*

MANUFACTURERS:—Whether you use heat for keeping your plant warm or in your manufacturing processes—whether for making armor-plate or baking enamel on cuff buttons, for making cartons or candy, rubber tires or hatching eggs or making tools, firearms or rubber goods or any other products that go through heat treating processes, you need in your plant *Tycos* Instruments for Indicating, Recording and Controlling Temperatures. Increased efficiency and savings can be made in every line of industry by applying *Tycos*—the Sixth Sense.

Write us for literature on any instrument, or type of instrument, and it will be sent promptly. Or, if you prefer, our engineers will consult with you on the application of *Tycos*—the Sixth Sense in your plant.

Tycos for the Home

Tycos Office Thermometers
An aid in promoting human efficiency.

Tycos Bath Thermometers
To enable you to get the most good from your bath.

Taylor Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

Taylor Quality Compasses
To show you the right way in unfamiliar country.

Tycos Fever Thermometers
A necessity in every home.

Tycos Stormoguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Tycos for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above

Write for Bulletin

Taylor Instrument Companies

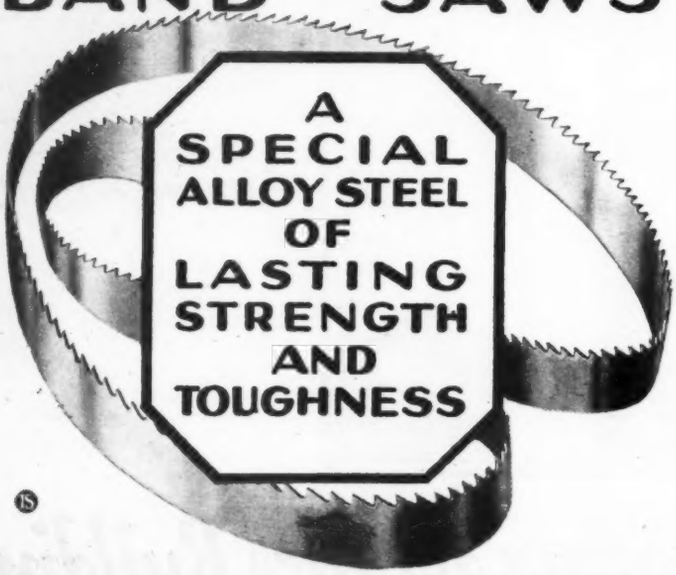
Main Office and Factory
ROCHESTER, N. Y. - - U.S.A.
Canadian Plant: *Tycos* BUILDING, TORONTO
SHORT & MASON, Ltd. Manufacturing Distributors in Great Britain

THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY

Tycos Temperature Instruments

INDICATING - RECORDING - CONTROLLING

SIMONDS
BAND SAWS

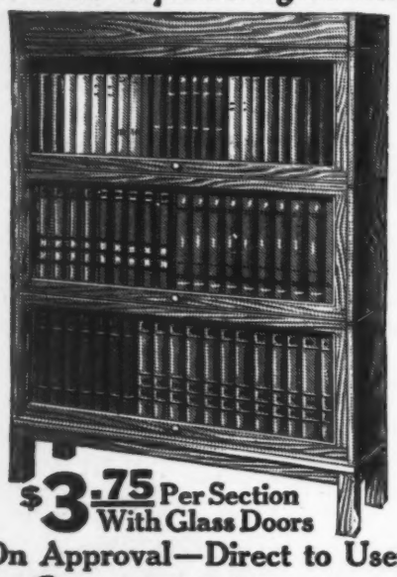


FROM specially tempered and treated alloy steel—with precision that is customarily associated only with fine mechanisms—with a knowledge of band saw requirements that is born of a near-century of experience in making cutting tools—a Simonds Band Saw is made to withstand the strains and stresses of the heaviest jobs. For longer service life, and the highest degree of safety and economy in band saw operation, specify "Simonds" when ordering.

SIMONDS SAW AND STEEL COMPANY, Fitchburg, Mass.

"The Saw Makers" Branch Stores and Service Shops in Principal Cities *Established 1832*

A Good Bookcase for the price of a good book!



$3.75 Per Section With Glass Doors

On Approval—Direct to User

Lundstrom

IT GROWS WITH YOUR LIBRARY

SECTIONAL BOOKCASE

Endorsed by Over 100,000 Users

Made for and universally used in the finest homes and offices throughout the country. Made in sections of different sizes, combining utility, economy and attractive appearance. Price complete as shown above, with **non-binding, disappearing, felt-cushioned** glass doors, beautifully finished in plain golden oak, $15.75. In quartered oak or in imitation mahogany or walnut (willow), $18.25. In genuine mahogany or walnut, $23.50. Other styles at correspondingly low prices. **Shipped direct from factory** at a big saving TO YOU. Write for new catalog No. 31.

The C. J. Lundstrom Mfg. Co., Little Falls, N. Y.

Manufacturers of Sectional Bookcases since 1899

Branch Offices and Warehouse: Kansas City, Mo.

Does work of 2 tools!

$2

At all leading hardware dealers. Or write us.

This perfectly balanced 1-pound hammer is made of tool steel. It has chisel-edged claws, without altering the claw feature. It has two small claws right and left to reach close corners next to wall. The head is correctly balanced making it possible to remove 10's at one pull. Write for fully illustrated folder.

Chisel-Edge Claw Hammer Co.
H. A. Ayvad, Hoboken, N. J., Dept. E

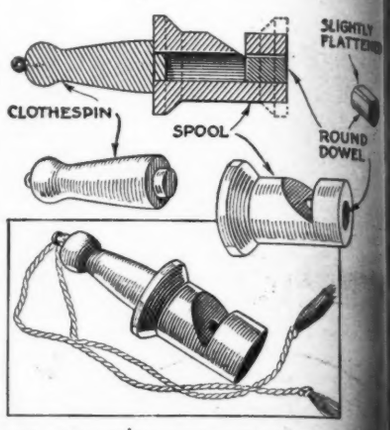
CHISEL-EDGE-CLAW HAMMER

Toy Whistle Made from Spool and Clothespin

By F. Clarke Hughes

TRIM the flange from one end of a spool, fit a piece cut from a clothespin into the large end of the spool as shown, and you have the beginning of a toy whistle.

Notch the spool about ½ in. from the end, barely cutting through into the hole in the spool. A dowel or a short piece of



Simple as it is to make, this gaily painted toy whistle is an attractive little article

a lead pencil will serve to plug the open end of the spool. The plug must be slightly flattened and the flat part placed to face the notch. Find by trial the position in which the plug allows the maximum sound to be produced; then glue it in place.

When the whistle has been painted in bright, glossy colors, a silk cord may be tied to the handle.

How to Extend the Height of a Small Stepladder

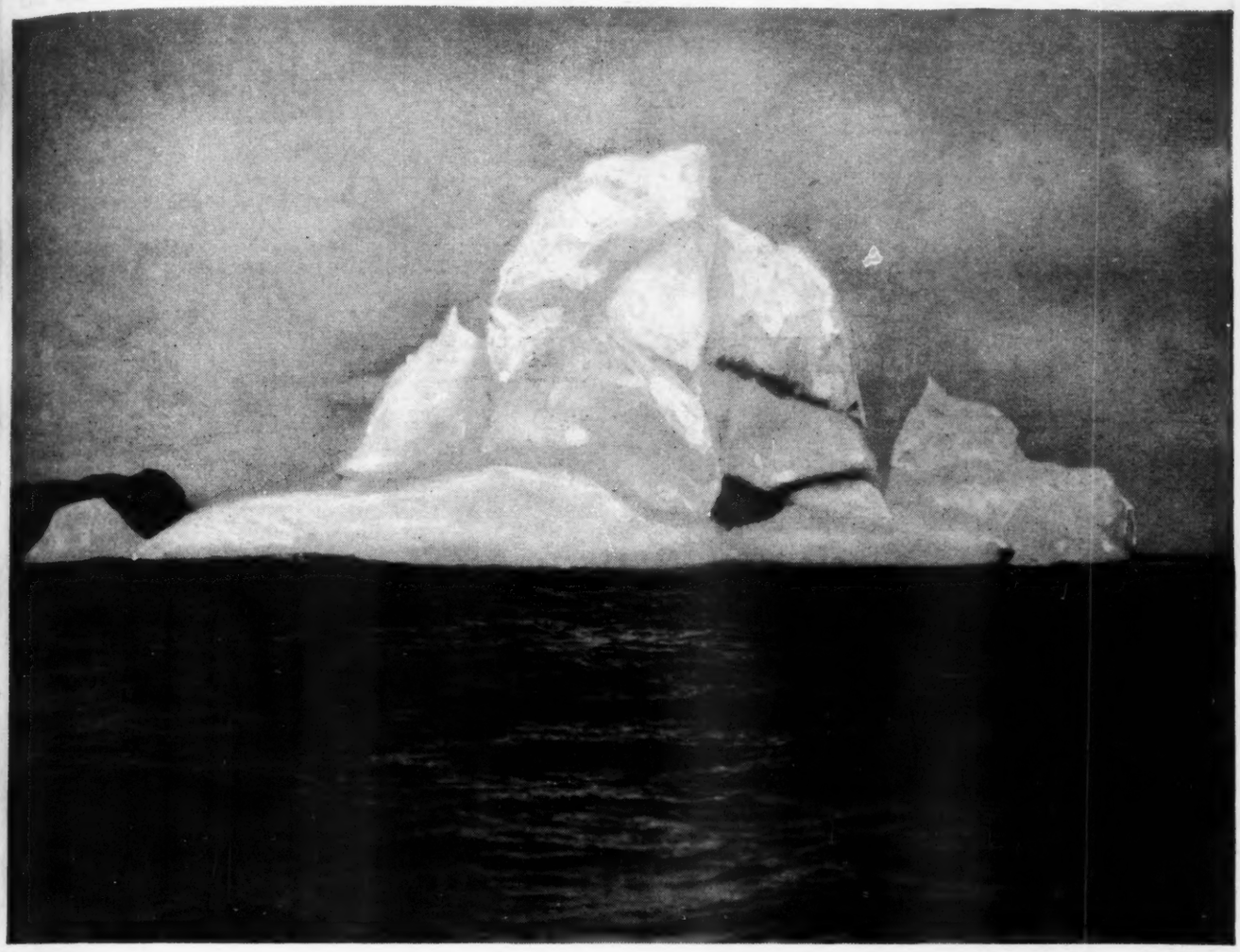
YOUR stepladder can be made several feet taller in a few minutes if you have ready the necessary extension pieces. Those shown are used to extend an 8-ft. ladder to 10 ft., but the same general plan can be followed for ladders of other sizes. The cost of a large stepladder is saved, there is some economy in storage space, and it is easier to carry the ladder on the running board of an automobile.

Detachable extension for light stepladder

The attachment for extending the steps was made in this case of two pieces of hardwood ⅞ by 2¾ in. by 4 ft., one piece ⅞ by 3¾ by 24½ in., and one piece ⅞ by 3¾ by 26 in. The extension strips for the back legs of the ladder are ⅞ by 1⅞ in. by 5 ft. 6 in. Four ⅜-in. and four ¼-in. machine bolts 2¼ in. long, with two washers each, are needed.—L. F. McIntyre.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

AFTER SHAVING



HERE IS A GOOD BET

Have you ever tried Listerine after shaving? You will like it.

We are so certain of this that we are willing to risk the cost of this page to tell you about it.

After your next shave, just douse Listerine on full strength and note results. Immediately, your skin will tingle with new life and vigor. Then, over your face will steal a lingering and delightful sense of coolness such as you have never known before.

And as it cools, Listerine also heals—takes the smart and burn out of tiny wounds left by the razor and lessens the danger of infection. Go ahead and try Listerine this way. We dare you.

EVERYBODY'S TALKING
Everybody's talking about the marvelous whiteness of teeth after using Listerine Tooth Paste a short time. You will be delighted. Large tube 25c.

Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

LISTERINE

—the safe antiseptic

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

30 Days Trial

New 1928 Models

5-Tube, 6-Tube and 7-Tube Sizes

5-6-7 Tubes
$47.00 to $72.00
Retail Prices Completely Assembled

Ⓢ Westgale One Dial Radio Sets

NOW!—the new 1928 Westgale line of Radio Models are ready for you to try. And we stand ready to put any one of our 24 new styles in your home and let you use it to your heart's content on 30 DAYS' TRIAL. Entertain your family and friends. Listen to programs from all over the country. Note the distance, selectivity, and volume. But most of all, hear their amazing deep, mellow tone,—then if you are not convinced that WESTGALE gives you more for your money than you can get elsewhere,—YOU DON'T HAVE TO KEEP IT.

Thousands of Westgale Sets have been sold on this 30 Day Trial Plan. For years we have built only quality sets at special low prices. These new 1928 models are no exception,—they are priced at just about half the usual cost. Why not save money? Why pay high prices? Why take chances, when you can test out any Westgale model in your own home on 30 Days' Trial?

The Last Word in Guaranteed Radio Sets and the Biggest Values Ever Offered

Why Not Be Our Agent?

Buy at cost. We want Agents and Dealers in every locality to demonstrate and take orders for these amazing new 1928 Westgale Models. This is your chance to get a Westgale Radio at a big discount and make it pay you big money. Millions of radios will be sold this season. Get a Westgale set on 30 days' Trial—demonstrate to your neighbors and friends and get your share of these big radio profits.

YOUR OWN RADIO FREE

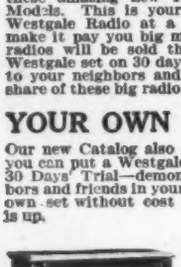
Our new Catalog also explains a plan whereby you can put a Westgale Radio in your home on 30 Days' Trial—demonstrate it to your neighbors and friends in your spare time and get your own set without cost before the trial period is up.

24 Styles to Choose From

Table Styles—Consoles De Luxe Cabinets

This season Westgale offers you 5-tube—6-tube—and 7-tube models in your choice of a beautiful array of table styles, consoles and period type Walnut cabinets.

Don't buy any radio until you send the coupon for our new catalog which pictures and describes our complete line in almost any size or style you could wish for. Don't wait,—a special introductory discount from retail prices for those who write quick. Mail the coupon today—get posted before you buy.



Special Discount to Agents

To quickly introduce these wonderful new 1928 models we are offering for a limited time a big reduction, way below retail prices on the FIRST Westgale set placed in each community. So get busy now. Be first in your locality to mail the coupon for our FREE catalog and get full particulars of this special discount offer.

Westgale Electric Co.
(Formerly Westingale Electric Co.)
Dept. 110
1751 Belmont Avenue
CHICAGO, ILL.

Mail Today—Don't Delay

Westgale Electric Co.,
Dept. 110, 1751 Belmont Ave.,
Chicago, Ill.

Please send me your FREE catalog on the new 1928 Westgale Radio Sets. Also full particulars of your special Discount Offer on the first outfit placed in each community.

Name.....
Address.....
.....

Daytime System—Nighttime protection for your tools provided by

Gerstner Tool Cases for MACHINISTS and TOOLMAKERS

Write for Free Catalog

H. GERSTNER & SONS
546 Columbia St., Dayton, O.

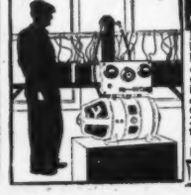
STEEL BLUE **Elite Diamond**
IF YOU CAN TELL IT FROM A DIAMOND
SEND IT BACK!

1 Carat Elite Diamonds; Matchless for their dazzling rainbow brilliancy. You'll be delighted. Elite Rings Surpass all others. Stand acid and other tests. Handsomely Engraved Ring sterling guaranteed. Looks like $250.00. Proud owner offered $85.00 5 minutes after buying one. Collar and Cuff Links FREE. With each ring order, we give free beautiful Combination Set set with small Elite Diamonds. SEND NO MONEY. Just send name, address and finger size. On arrival pay postman $3.89 and postage. Satisfaction Guaranteed. Write today. Cash with Canadian or foreign orders.
Elite Jewelry House, Dept. 380, 609 S. Paulina St., Chicago, Ill.

100 SCALE PLANS OF OLD and MODERN SHIPS

Easy to build and sell ship models. Send 6 cents for catalog of over 100 plans, books, prints, maps and other things that smack of the sea.

SEA ARTS GUILD
405-N ELEVENTH AVE. MILWAUKEE, WIS.



YOU CAN CLEAR $150 to $300

HB One Day Charging starts you making big money recharging auto and radio batteries. $150 to $300 monthly profits easily made. **Only $35 cash brings complete HB One Day Battery Charging Outfit.** Easy payments. No experience needed. Lowest-Priced complete One Day Charging Outfit on the market. **30 days' trial on money-back guarantee. Write for free bulletin.**
HOBART BROS. CO.
Box P107 - - Troy, Ohio
HB ONE DAY BATTERY CHARGING

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

ACETIC acid is one of the weaker organic acids. Commercial acetic acid, which usually contains about thirty percent of the acid in water, is sufficient for the majority of requirements in the home workshop. Vinegar, which contains from two to four percent of this acid, may also be used where a highly diluted solution is required.

Pure acetic acid, known as glacial acetic acid, is more convenient to use, as it may be diluted to any degree with water. It is a crystalline substance, which melts at 62 degrees F., although it is a liquid at ordinary room temperatures. It is soluble in water, alcohol and ether, and dissolves camphor, resins, coagulated albumin, and small portions of phosphorus. The acid, which has a penetrating odor, should not be brought in contact with the skin for any length of time, as it produces blisters.

WARM vinegar or dilute acetic acid will dissolve the tarnish on copper, brass or bronze. This is accomplished simply by rubbing the metals with a rag moistened with the acid. As soon as the tarnish has been removed, all traces of the acid must be washed off with plenty of water. A clean rag is then used to dry the surfaces.

To make the article assume a bright luster, rub the cleaned and dry metal with whiting (precipitated chalk) on a cloth.

Peculiar as it may seem, it is possible to make a colored water varnish with a very dilute acetic acid or vinegar. Thoroughly mix dry sienna, a powder which can be obtained in almost any paint store, with a little vinegar to make a mixture like paste in consistency. Then add more vinegar until the correct proportion of color is obtained by trial on a small piece of wood. Apply and let dry thoroughly. Rub vigorously with a clean rag, using a little pressure, until the surfaces are shiny and then polish with floor wax, if desired.

This varnish should, of course, be used only for articles of no particular value or of a temporary nature, when the expense of applying a first class stain and varnish is not warranted. It has been used by the writer for finishing ordinary shelves, where it does good service.

The following label is intended to be pasted on the acetic acid bottle:

Acetic Acid
CH_3COOH

Keep in glass stoppered bottle. Since the pure (glacial) acid freezes easily below 59 degrees F., keep it in a comparatively warm place. If the liquid should freeze, place the bottle in warm, not hot, water after loosening the stopper.

A liquid glue is obtained by adding the acid to a hot, thick solution of carpenter's glue.

A very dilute solution of acetic acid (or vinegar) will remove the tarnish from brass, copper, and bronze, but all traces of the acid must be removed with water or the metal will again tarnish rapidly.

A water varnish-stain for use on articles of little value or of a temporary nature is obtained by mixing dry sienna with a very dilute solution of acetic acid (or vinegar).

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Restored Enchantment

This is the Eveready Layerbilt that gives you Battery Power for the longest time and the least money.

Radio is better with Battery Power

THERE is no doubt of it—radio is better with Battery Power. And never was radio so worthy of the perfection of reception that batteries, and batteries alone, make possible. Today more than ever you need what batteries give—pure DC, Direct Current, electricity that flows smoothly, quietly, noiselessly. When such is the current that operates your receiver, you are unconscious of its mechanism, for you do not hear it humming, buzzing, crackling. The enchantment of the program is complete.

Batteries themselves have improved, as has radio. Today they are so perfect, and so long-lasting, as to be equal to the demands of the modern receiver. Power your set with the Eveready Layerbilt "B" Battery No. 486. This is the battery whose unique, exclusive construction makes it last longer than any other Eveready. Could more be said? In most homes a set of Layerbilts lasts an entire season. This is the battery that brings you Battery Power with all its advantages, conferring benefits and enjoyments that are really tremendous when compared with the small cost and effort involved in replacements at long intervals. For the best in radio, use the Eveready Layerbilt.

At a turn of the dial a radio program comes to you. It is clear. It is true. It is natural. You thank the powers of nature that have once more brought quiet to the distant reaches of the radio-swept air. You are grateful to the broadcasters whose programs were never so enjoyable, so enchanting. You call down blessings upon the authority that has allotted to each station its proper place. And, if you are radio-wise, you will be thankful that you bought a new set of "B" batteries to make the most out of radio's newest and most glorious season.

NATIONAL CARBON CO., INC. UCC New York—San Francisco

Unit of Union Carbide and Carbon Corporation

EVEREADY
Radio Batteries
—they last longer

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time

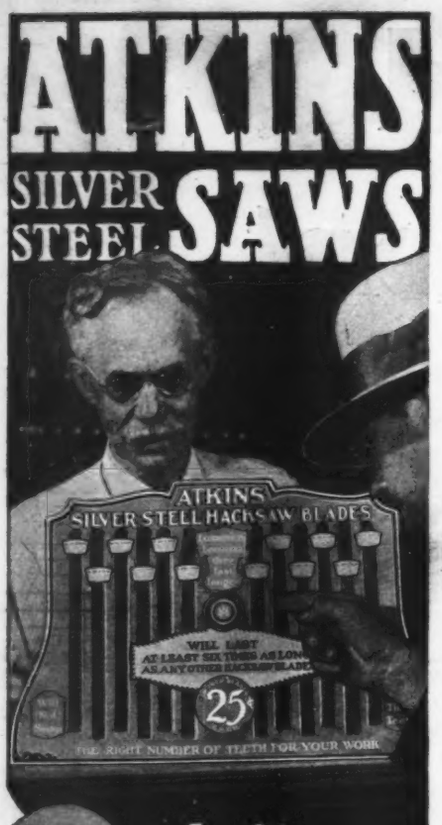
WEAF—*New York*	WGR—*Buffalo*	WGN—*Chicago*	WRC—*Washington*
WJAR—*Providence*	WCAE—*Pittsburgh*	WOC—*Davenport*	WGY—*Schenectady*
WEEI—*Boston*	WSAI—*Cincinnati*	WCCO { *Minneapolis* / *St. Paul*	WHAS—*Louisville*
WDAF—*Kansas City*	WTAM—*Cleveland*		WSB—*Atlanta*
WFI—*Philadelphia*	WWJ—*Detroit*	KSD—*St. Louis*	WSM—*Nashville*
		WMC—*Memphis*	

Pacific Coast Stations—9 P. M., Pacific Standard Time

KPO—KGO—*San Francisco* KFI—*Los Angeles*
KFOA—KOMO—*Seattle* KGW—*Portland*

Have you heard the new Victor record by the Eveready Hour Group—orchestra and singers—in Middleton's Down South Overture and Dvořák's Goin' Home?

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. **See page 6.**


ATKINS
SILVER STEEL SAWS
ATKINS
SILVER STEEL HACKSAW BLADES
WILL LAST AT LEAST SIX TIMES AS LONG AS ANY OTHER HACKSAW BLADE
25
THE RIGHT NUMBER OF TEETH FOR YOUR WORK

At Your Hardware Store

ATKINS-SILVER STEEL MADE IN U.S.A.

"Silver Steel" Hack Saw Blades

Cut Twice as Fast

Last Six Times as Long

YOUR Hardware Dealer can show you the wonderful NEW Atkins "Silver Steel" Hack Saw Blades that revolutionize metal cutting. Made of perfected steel that cuts twice as fast and six times as long as any ordinary blades. You save time, money and labor on every blade.

The display illustrated above shows Atkins "Silver Steel" Hack Saw Blades for every hand metal cutting operation. Power blades are made of the same material! We will gladly send information showing savings on any metal cutting.

E. C. Atkins & Co.

Established 1857

Leading Manufacturers of Highest Grade Saws for Every Use; Saw Tools, Saw Specialties, Plastering Trowels, Machine Knives, Grinding Wheels and Files

428 So. Illinois St.
INDIANAPOLIS, U.S.A.

The Shipshape Home

Questions Our Readers Ask about Finishing Woodwork

THAT the finishing of woodwork and furniture is a matter of the keenest interest to many readers of POPULAR SCIENCE MONTHLY, is made clear by the number of letters received in regard to painting problems.

Refinishing furniture is lucrative occupation

Among the questions recently brought up, the following are representative. They relate to problems frequently encountered in the average home. The answers, which are by Berton Elliot, one of the leading authorities on painting and decorating, may help you in doing similar work easily and successfully.

How can I remove the paint from the woodwork in a room? Two years ago two coats of paint were put on the woodwork, which had previously always been varnished. The paint has cracked so badly, I wish to have it removed before refinishing.

NO MATTER how many coats of paint or varnish have been applied, or when, they can be removed clear to the wood with a paint and varnish remover.

The remover is applied with no more brushing than is necessary to cover the surface. It is allowed to stand for a few minutes, when the old coatings will have become so soft that they may be readily scraped off with a putty knife. Moldings, corners and other places that are hard to get at may be cleaned with a small vegetable brush.

After the old coatings have been stripped off, it is essential to clean up the surface by washing with a generous quantity of gasoline, benzine or denatured alcohol. If every trace of the paint remover is not removed, it will interfere with the drying of subsequent coats and cause serious trouble.

In refinishing an old china closet, to which some new wood has been added, how shall I go about it so that the new wood will not look lighter than the old?

THIS is a problem that often comes up when built-in features are added or interior woodwork and floors are repaired. The first step is to sandpaper the new wood to extreme smoothness and dust the surface clean. (*Continued on page 114*)

Comes from the Can Like Putty

PLASTIC WOOD

Hardens into Solid Wood

It solves the problem of damaged woodwork and is invaluable around the house. It sticks everlastingly to metal, wood, stone, plaster or fabric; takes paint, stain, varnish or lacquer; is workable with tools, but will not chip or splinter.

¼ lb., 35c.; one pound $1.00
Sold by Hardware and Paint Stores.
Send coupon if they cannot supply you

ADDISON-LESLIE COMPANY
37 Bolivar Street, Canton, Mass.
Please send me ¼ lb. can of PLASTIC WOOD for which I enclose 35c.

Name.....

Address.....

Dyke's Automobile Encyclopedia

Entirely Rewritten, Rearranged and Illustrated. Greatly Enlarged; 1238 Pages, 4143 Illustrations.
A PRACTICAL BOOK FOR EVERYBODY

The Repairman will find this book a ready reference and guide.
The Auto Owner will know how to diagnose troubles and learn when repairs are done right.
The Student learns the fundamental principles the key to a successful repairman.

This Book Will Teach you to Become

An *Expert Automobile Repairman*, not only on *testing, adjusting and repairing* engines, carburetors, clutches, rear axles, differentials, tires, etc., but an *Electrical Expert* on ignition, generators, starting motors, storage batteries, etc. Diagnosing any trouble will be easy.

DON'T WAIT—*Order Now!*

Cloth $6
Limp American Morocco $7.50 Postpaid

POPULAR SCIENCE MONTHLY
250 Fourth Ave. New York City

OTTAWA LOG SAW ONLY $39

GREATEST OFFER EVER MADE

PUTS THIS OTTAWA TO WORK FOR YOU

BIG BOOK FREE

Make Money! Wood is valuable. Saw 15 to 20 cords a day. Does more than 10 men. Ottawa easily operated by man or boy. Fells trees—saws limbs. Use 4-hp. engine for other work. 30 DAYS TRIAL. Write today for FREE book. Shipped from factory or nearest of 10 branch houses.

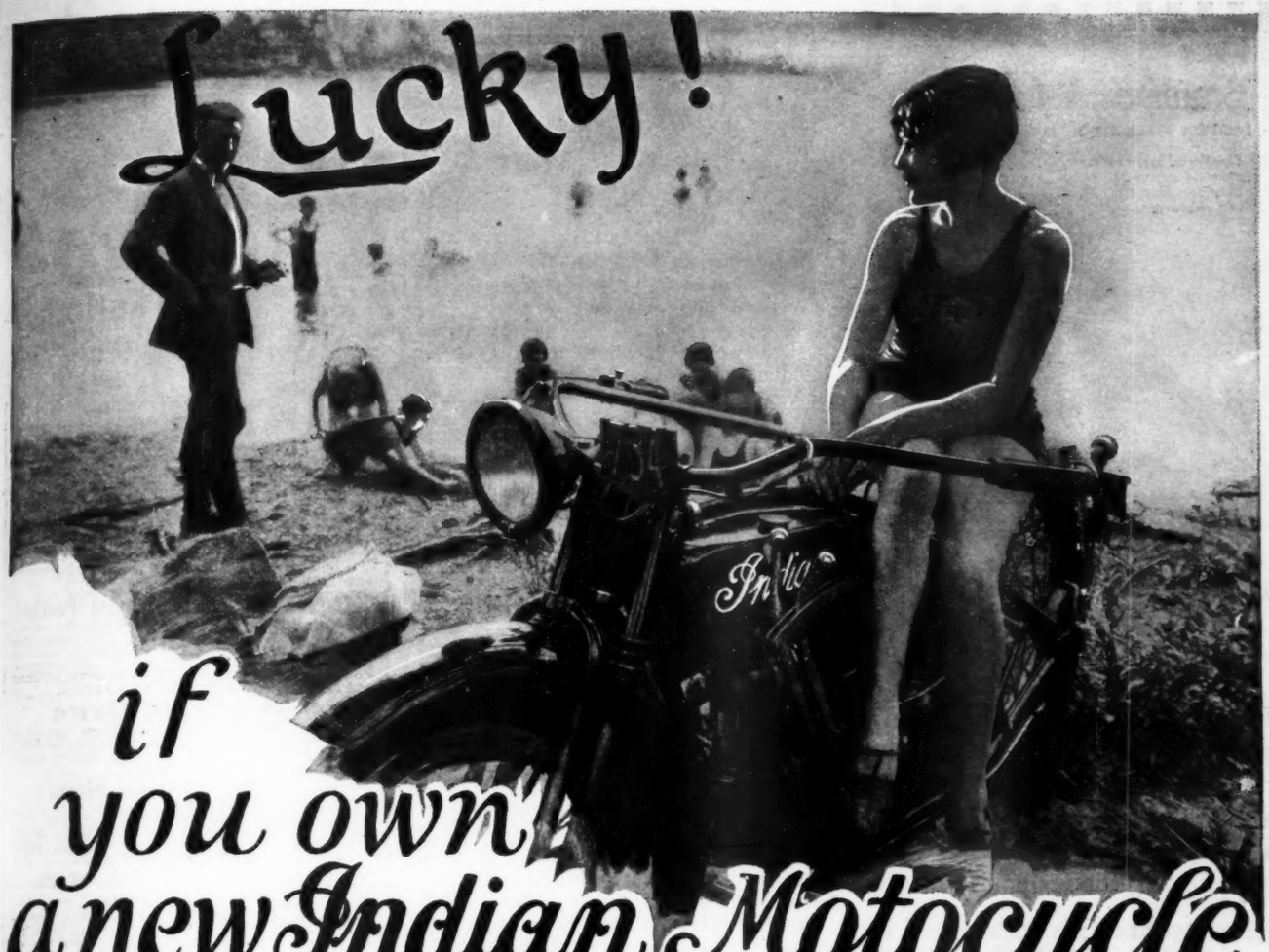
OTTAWA MFG. CO. 1901-W Wood Street, Ottawa, Kansas. Room 1901-W Magee Bldg., Pittsburgh, Pa.

TWO FREE BOOKS

Breed squabs and make money. Sold by millions at higher prices than chickens. Write at once for two free books telling how to do it. One is 40 pages printed in colors, other 32 pages. Ask for Books 3 and 4. You will be surprised. Plymouth Rock Squab Company, 616 H Street, Melrose Highlands, Massachusetts.

MAKE MORE MONEY

Read the Money Making Opportunities on pages 150 to 182 of this issue.



INDIAN owners are masters—of the open road, for Indian power and stamina bow to none—masters of secluded beauty spots, for an Indian will carry you *anywhere*—masters of long hours of delightful health building recreation, for an Indian makes the beach, the ball game, the camping ground, golf, or your best girl right around the corner, for its lucky owner.

Now Ready

For 1928 Five New Models

Over *Forty* Important Improvements

PICK the one that's built for you from the world's most complete cycle line. It is transforming motorcycle History.

Indian
WORLD'S MOST COMPLETE CYCLE LINE

For demonstration call on the nearest Indian dealer. Generous pay-as-you-ride plan. Write for Catalog.

Indian Motocycle Company
Springfield Mass.

Indian Motocycle Co.
Dept. P-201, Springfield, Mass.
Send me your new Catalog.

Name.....

Address.....

City..... State.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Bradleyunit-A
PERFECT FIXED RESISTOR

Unaffected by temperature, moisture or atmospheric changes. Does not age or change in resistance.

A solid-molded fixed resistor, baked under high pressure, and accurately calibrated. Can be soldered without affecting accuracy.

Two Remarkable Radio Resistors

Bradleyunit-A is an outstanding success! It is a fixed resistor for radio circuits of all kinds, and has a capacity of 2 watts. It is rugged and can be soldered easily, without affecting the rating of the unit.

Bradleyohm-E is widely used by manufacturers of B-Eliminators for plate voltage control. Its remarkably wide, noiseless range, accomplished with two columns of graphite discs, accounts for its tremendous popularity.

Use Allen-Bradley resistors in your own hook-ups for superlative results. Follow the example of prominent radio manufacturers. They know!

Bradleyohm-E is available in several ranges and ratings. Sold in distinctive checkered cartons. Ask your dealer for Bradleyohm-E

Allen-Bradley Co.
ELECTRIC CONTROLLING APPARATUS
293 Greenfield Ave. A-B Milwaukee, Wis.

The Shipshape Home

(Continued from page 112)

Bring up the new wood to the same tone as the previously finished part by applying a coat of stain that approximates as closely as possible the color of the previous finish. If a very light finish, it may be necessary to thin a standard stain greatly and to wipe on just a touch with a cloth rather than to apply a brush coat. Oil stains are the easiest for the amateur to use for this work.

If the wood is open grained, it must be filled as previously explained.

Next, go over the entire surface, new wood and old wood, with a coat of varnish-stain of the color desired for the new finish.

A finishing coat of clear gloss varnish then should be applied. If desired, a semidull finish may be produced by rubbing this coat with pumice stone and oil (or water), or by applying a coat of flat varnish.

I have a chest of drawers that is now stained golden oak, and I would like to change the color to walnut.

ANY piece of stained furniture may be easily refinished in walnut or the brown mahoganies now so popular. First remove the old finish, as previously explained. While paint and varnish remover will not entirely remove some stain that has penetrated deeply into the wood, this residue will have no material effect.

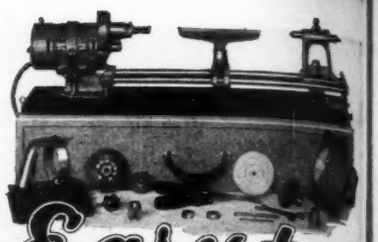
In building up the new finish, sandpaper if necessary, then apply a coat of stain of the desired color, preferably a penetrating stain.

It should be remembered that the effect produced by any stain varies with different woods. It may also be varied by manipulating the stain. For instance, a heavy or light coat may be applied. A lighter effect may always be had by reducing the stain with turpentine or whatever thinner the manufacturer recommends, or by wiping off some of the stain with a cloth immediately after it has been applied. A small surface on the back or underside should be stained first to test the effect.

After the stain has dried overnight, open grained woods, such as oak, walnut, mahogany and chestnut, must receive a coat of filler. Close grained woods, such as pine, maple, birch, poplar and whitewood, do not require a filler. *Paste* filler is the most satisfactory. It is reduced with benzine or turpentine to the consistency of thick cream and applied with a brush. As soon as it commences to set, which is indicated by a flatting out in color, it is wiped off clean with a cloth *across* the grain.

Next, apply a coat of thin orange shellac to seal in the stain so it will not bleed through the finishing coats of varnish. When dry (in not less than two hours) sandpaper lightly and dust clean. Then apply a coat of high grade gloss finishing varnish.

If the popular semidull finish is desired, it may be produced by applying another coat of gloss varnish and rubbing with fine pumice stone *(Continued on page 116)*



Easy to Make Things at Home with *SpeedWay* Shop!

HAVE fun and make money! Try it for ten days right in your own home. See how practical this wood and metal working outfit is. For mechanics, repair men, handy men.

Yours for 10 Days Free
Take advantage of our 10 days' free trial offer! Test the Super SpeedWay Shop in your own home! If it fails to do what we claim for it, we will cheerfully refund the ten dollars.

Eight Motor Driven Tools
Super SpeedWay Shop gives you a privately owned machine shop right in your home. This sturdy combination of tools gives you a complete Lathe—a Bench Saw—a Jig Saw—a Portable or Stationary Power Drill, especially equipped for buffing, grinding and cleaning. Works from any lamp socket.

Only $10.00 Down
Pay while you are enjoying your Super SpeedWay Shop. Only $10 down and balance in easy monthly payments, puts one of these sturdy, efficient Super SpeedWay Shops in your home.

Free Blue Prints
We furnish 24 working blue prints free with each SpeedWay Shop. Enables you to make attractive furniture, novelties, toys, radio work, bric-a-brac for gifts or sale.

Don't Delay—Write Today
Remember—the Shop is a money-maker for the small-job man, and fun for the man who has learned the joy of working with tools at home. Write today.

SpeedWay—A Complete Line
The makers of Super SpeedWay Shop are the world's only manufacturers of a *complete* line of Portable, Electrically Driven Saws, Hammers, Drills, etc.

Sales and Service in All Principal Cities

Electro Magnetic Tool Co.
1830 S. 52nd Ave., Cicero, Ill. (Adjoining Chicago)

Manager, Dept. 5-O. Please send me full particulars about your 10-day free trial on the SpeedWay Shop. (If interested in other tools, please write.)

Name .....

Address .....

FREE CATALOG
Hunting shoes, leather hats, caps, and jackets. 40 items.
L. L. BEAN
22,000 Main St.
Freeport, Me.

MOVIES In Your Home
Our marvelous, practical Movie Machines sell as low as $3.75 postpaid, and use same size film as big theatres. We also have wonderful films at lowest prices—with a new film exchange service.
Don't Miss This!
Write NOW for Free Catalogue.
PARAMOUNT MANUFACTURING CO.
Dept. 1371-P, Boston, Mass.

They Grinned When the Waiter Spoke to Me in French

—but their laughter changed to amazement at my reply

WE had dropped into Pierrot's for dinner—Pierrot's, that quaint French restaurant where the waiters speak nothing but French. Jack Lejeune, who boasted a smattering of French, volunteered to act as interpreter.

"Now tell me what you want to eat," announced Jack grandly, after we were seated, "and I'll 'parley' with the waiter."

With halting French phrases and much motioning of hands, Jack translated our orders to the waiter. Finally Jack turned to me.

"What's yours, Fred?" he asked.

"Virginia ham and scrambled eggs," I replied.

Jack's face fell. He knew that my order would be difficult to translate into French. However, he made a brave effort.

"Jambon et des———et des———" but Jack couldn't think how to say "scrambled eggs." He made motions as if he were scrambling eggs in a frying pan, but the waiter couldn't get what he was driving at.

"I'm afraid you'll have to order something else, Fred," he said finally. "I can't think of the word for 'scrambled eggs.'"

Everybody smiled—everybody except me. With great ceremony I beckoned to the waiter. "I'll explain my order to the waiter," I said. A chuckle ran around the table.

"Fred can't speak French, can he?" I heard a girl whisper to Jack.

"No—he never spoke a word of French in his life," came the answer. "But watch him. This will be funny. He'll probably give an imitation of a hen laying an egg."

A Tense Moment

The waiter addressed me. "Monsieur a fait son choix?" he asked.

There was a pause. All eyes were on me. I hesitated—prolonged the suspense as long as possible. Then in perfect French I said to the waiter: "Oui, Donnez moi du jambon aux oeufs brouillés—jambon de Virginie."

The effect on my friends was tremendous. The laughter stopped. There were gasps of amazement. In order to heighten the effect, I continued for several minutes to converse in French with the waiter. I asked him all sorts of questions—what part of France he was from—how long he had been in America, and many other queries. When I finally let the waiter go, everybody started firing excited questions at me.

"Fred! Where did you learn to speak French like that?" "Why didn't you tell us you could talk French?" "Who was your teacher?"

"Well, folks," I replied, "it may sound strange, but the truth is I never had a teacher. And just a few months ago I couldn't speak a word of French."

"Quit your kidding!" laughed Jack. "You didn't develop that knowledge of French in a few months. I thought it took years to learn to talk like that."

"I have been studying French only a short while," I insisted. And then I told them the whole story.

How I Learned French Without a Teacher

"Did you ever hear of the House of Hugo?" I asked.

Jack nodded. "That's that famous Language Institute over in London, isn't it?"

"Yes," I replied. "They've been teaching languages for over a century. Thousands of Europeans have learned foreign languages in a surprisingly short time by their 'at-sight' method."

"But what's that got to do with your learning French," asked Jack. "You haven't been over there taking lessons from the House of Hugo, have you?"

"No, I couldn't go to the House of Hugo, so the House of Hugo came to me," I replied quizzically.

My Friends Looked Startled

"Here's what I mean," I said. "The authorities of the House of Hugo got together recently and decided to condense their knowledge of language instruction—their experience in teaching French—the secrets of their wonderful method into a *course of printed lessons*—a course which anyone could study at home.

"This course turned out to be the most ingenious method of learning French ever devised. It was simply marvelous. It enabled people to learn French in their own homes, in an incredibly short time.

"I can scarcely believe it myself, but just a few months ago I didn't know a word of French. Now I can speak and understand French when it is spoken to me. And I didn't study much—just a few minutes a day. There were no laborious exercises to do—no tiresome rules—no dull class-room drills. It was actually fun learning. Everything was so clear, so simple, so easy. Honestly, the Hugo 'At-Sight' French Course is the most remarkable thing of its kind I have ever seen!"

Try It 5 Days FREE

This story is typical. You, too, can now learn French at home—quickly, easily, pleasantly—just as thousands of others are doing by the celebrated Hugo "At-Sight" Method. Twenty-four fascinating lessons, carefully planned. The most ingenious method of learning French ever discovered. Whole generations of language-teaching experience in all the leading European cities are behind this French course.

The wonderful thing about this simplified Hugo method is that it makes you *your own teacher*. At home—in minutes that might otherwise be wasted—you learn, phrase by phrase, sentence by sentence, to speak the language correctly and well. To be able to speak French is decidedly a cultural attainment, and is recognized as such. Use those spare minutes to master French this fascinating Hugo way!

No money is necessary now. We shall be glad to send you the complete course FREE FOR 5 DAYS so that you may see it and judge it for yourself. Within the free examination period you have the privilege of returning the course without cost or obligation, or keeping it as your own and sending only $2 as a first payment and thereafter $2 a month until the full price of $12 has been paid.

You are the judge. Simply return the course within 5 days if you are not fascinated and delighted with it. If you act promptly, a valuable French-English Dictionary, containing 45,000 words, will be included without additional cost.

We urge you to clip and mail this coupon today. Doubleday, Page & Co., Dept. F-9810, Garden City, New York.

Doubleday, Page & Co., Dept. F-9810,
American Representatives of Hugo's Language Institute of London,
Garden City, New York

Please send me the Hugo "French-at-Sight" Course in 24 lessons, for free examination and include the French-English Dictionary. Within 5 days I will either return the course and dictionary, or send you $2 at that time and $2 each month thereafter until $12 has been paid.

Name.....

Address.....

City.....State.....

Occupation.....

5% discount for cash with order

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Are you still living in the coal age—

or is yours a modern home?

EVEN the most progressive people are a little backward about some things. You probably know families yourself who have electric refrigerators, vacuum cleaners, gas ranges, all the latest improvements—except the one that for Simon-pure comfort and convenience is worth more than all the others combined—*automatic oil heat.*

Until you've tried it yourself, you'll have no conception of what solid comfort and convenience—what unalloyed pleasure there is for all the family in automatic oil heat. And until you've seen the new silent Nokol in action, you'll never know oil heat at its best. Nokol operates on a different principle from all other oil burners—a principle that insures *perfect combustion* always—cleanliness, unvarying temperatures, total freedom from smoke, soot, odor and oily film. And an operating cost that compares most favorably with coal.

Learn about Comfort from Nokol

Whether you are ready for it now or not, sooner or later you will join the progressive throng who regard oil heat as a modern necessity; sooner or later you'll put your home on the right side of *"The Dividing Line."* Mail the coupon today for instructive booklet and details of our new budget plan.

NEW *Silent*

NO COAL **NOKOL**

REG. U.S. PAT. OFF.

AUTOMATIC OIL HEATING FOR HOMES

FREE—NEW BOOK

AMERICAN NOKOL COMPANY
4182 Shubert Ave., Chicago
Please send me your new book on OIL HEAT FOR HOMES.

Name.....

Address.....

City.....State.....

The Shipshape Home

(*Continued from page 114*)

and oil or pumice stone and water, or else by applying a coat of flat varnish. Application of this varnish will cause the wood to dry naturally to a dull finish.

Rubbing is done as follows: Place a small amount of powdered pumice stone in a saucer or other shallow receptacle. A piece of rubbing felt or a cloth folded into a pad, is dipped first into the oil (or water), then into the pumice, and rubbed lightly several times over the surface. Be especially careful in doing this not to cut through the edges.

When the surface has been rubbed uniformly, it should be cleaned up thoroughly with clean cloths.

The foregoing method will produce the finest finish. In case the piece of furniture is not such that you want to put this amount of work into it, a good, quick finish may be produced by sandpapering the old coating thoroughly, dusting clean, and applying a coat of varnish-stain of the desired color, followed by a finishing coat of gloss or flat varnish, as you may prefer.

Would you please tell me how to produce a gray stain effect on oak?

A LITTLE experimenting is generally necessary in order to obtain just the effect desired, as various grayish tones may be produced by a slight manipulation of the materials. A few small pieces of oak can usually be obtained from a lumberyard or a new building for your experimental work.

Oak, of course, always has to be filled, and by using a gray filler, a grayish effect is produced. While it is generally impossible to obtain a gray filler already prepared, "light," "natural" or "transparent" filler may be obtained at any paint store, to which a little dry white lead and a touch of lampblack can be added, giving a grayish color, the tone of which may be varied by the amount of white and black used. A little aluminum bronze, if added to the filler instead of the white and black, gives a pleasing effect. After applying the filler and wiping it off in the regular way, the final coat may be clear varnish.

If none of these effects is just what is desired, try going over the filled wood with one of the gray stains on the market, wiping it off with a cloth if too intense in tone.

Another method sometimes employed is to use gray brushing lacquer reduced fifty percent or more with lacquer thinner. This is applied directly to the wood and immediately wiped off with a cloth. In applying this brushing lacquer speed is necessary because of the rapidity with which the lacquer dries.

After obtaining the gray color, the surface should be finished in the standard way. That is, a coat of shellac is employed to seal in the stain, if stain is used, followed by one, two or three coats of gloss varnish.

Rub the last coat, if desired, or apply instead a coat of flat varnish.

RADIO CATALOG *free*

2000 Exceptional Radio Values

1928 WHOLESALE CATALOG of RADIO Sets, Kits and Everything in Radio

Every Set Builder Needs This Book

Every live dealer in radio sets, parts, accessories, supplies, etc., should have a copy of this bargain catalog. You will be amazed at the thousands of money saving radio items illustrated and listed in this storehouse of everything you could possibly need in radio.

The GUIDE BOOK to Bigger RADIO PROFITS FOR YOU

The book contains all the latest and most popular kits—all the famous, nationally known radio parts, accessories and supplies—the very newest types and designs of table cabinets and consoles—everything at prices that mean bigger profits for you.

Short Wave Section Our catalog contains a section devoted to a showing of the highest grade short wave receiving and transmitting apparatus. Also the finest electrical appliances for use in the home.

Dealers Make More Money! Tie up with a house that carries large, complete stocks, that gives you the highest quality radio parts, that insures speedy shipments and 100% satisfactory service. Our wholesale vest pocket price list and discount sheet and catalog will be sent to you on request. Write on your letterhead.

BUT WRITE QUICKLY

SHURE RADIO COMPANY

337M Madison Street Chicago, Illinois

RADIO AGENTS Make Big Money

EASY to sell American Radios and Supplies. Nationally advertised, high quality merchandise at wholesale. Big profit on every sale. No capital to invest. No stock to carry. Order direct from my huge warehouse as you sell. Get My Liberal Offer and also Big New 132-page Catalog and Guide—"How to Sell Radios"—Free. Full of Bargains—all latest in Radio. Write today.

AMERICAN AUTO & RADIO MFG. CO.
HARRY SCHWARTZBERG, PRES.
Dept. 285 American Radio Bldg., Kansas City, Mo.

FREE BIG BARGAIN CATALOG

BURN YOUR NAME ON TOOLS WITH THE ARKOGRAF

Protect Your Tools From Theft. Write with electricity any name or design on the hardest and finest tools and instruments, or any metal, like writing on paper with pen or pencil. Complete Outfit $3.50 Prepaid Anywhere. Interesting illustrated circular free. Write today. Agents wanted.

ARKOGRAF PEN CO.
1171-A East Stark St., Portland, Oregon

BUILD BUSINESS WITH AIR!

Only $12 monthly for a few months buys the best business builder and advertisement your shop can have if you sell to the car owner. Tire Stores, Garages, Battery Shops, Filling Stations are making big money with the new low-priced HB Automatic Air Compressor—priced $75 to $100 less than similar equipment on the market. Ask for bulletin AC 6—Tells all about it.

HOBART BROTHERS CO.
BOX P1071 TROY, Ohio

Print Your Own

Cards, stationery, labels, paper, circulars, tags, menus, heads etc. Save money and time, cut cost in half. Sold direct from factory. Pays for itself in a short time. Complete Outfits, $8.86 up. Job Press, $11, $29; Rotary $54. Print for Others, Big Profits. All easy, rules sent. Write for catalog of presses, type, paper, cards, envelopes, paper cutters.

EXCELSIOR

The Kelsey Co., P-33, Meriden, Conn.

THE REAL ESTATE EDUCATOR

The New Revised Edition, 1927, contains Questions and Answers; Brokers' License Law; Dictionary of Words and Phrases in Real Estate and Construction; How to Appraise Property; Law of Real Estate; How to Advertise Real Estate; Legal Forms; Commissions to Agents; Savings and Loan Associations; "Don'ts" in Contracts, etc., and other useful information. 253 pages. Cloth. Postpaid $2.00.

Popular Science Monthly, 250—4th Ave., New York.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Plug In-and Tune In

30 Days Free Trial

Now! A Real Electric Radio Set

Three Year Guarantee

Shipped direct from our factory at rock bottom prices—cost less than most battery sets

No Batteries, Chargers or Eliminators

No Acids; No Liquids—Plug In—Press Button—"Tune In"

Metrodyne

ALL ELECTRIC RADIO

AGENTS! DEALERS! BIG PROFITS!

Make big money taking orders for Metrodynes. All or part time. Metrodyne All Electric Radios are in a class by themselves. Marvelous quality, performance and price. Demonstrate at home and take orders. Lowest wholesale prices. Your demonstrating set on 30 days' free trial. Mail coupon below for details.

7 Tubes—Single Dial Set

100% Electric Radio

At last! The radio you've dreamed about! If you have electricity in your home you can now really enjoy **long distance** radio reception without the care, bother and muss of batteries, chargers, eliminators, etc. The **Metrodyne All Electric** is a real, genuine **batteryless** radio set. Simply insert the plug in the socket, press the switch button and "tune in." You could not possibly buy a better radio set than the **Metrodyne All Electric**, no matter what price you paid.

BEAUTY—EFFICIENCY DEPENDABILITY

The Metrodyne All Electric Radio is a 7 tube, single dial set. Only the highest quality low loss parts are used throughout. Solid walnut cabinet, beautiful two-tone effect, with handsome gilt metal trimmings. Size of cabinet, 28 inches long, 13 inches deep, 10 inches high. Has electrically lighted dial so that you can log stations in the dark. Only one dial to tune in all stations. Excellent tone qualities—wonderful volume—very selective.

Gorgeous Console Electric Radio

Here is the Metrodyne All Electric Console Radio—a gorgeous, genuine walnut cabinet, in a beautiful two-tone finish. Has a built-in genuine Metro-Cone large size speaker. Brings in programs with great volume, reproducing the entire range from the lowest to the highest notes with remarkable clearness and distinction. All metal parts are finished in old gold. Wonderful electric radio, in a cabinet that will beautify the appearance of any home.

Costs Less Than Most Battery Sets

Do not confuse the Metrodyne electric radio with ordinary light socket sets, because the Metrodyne is truly an **all electric radio**—consumes less than 2c worth of power a day. Comes to you **direct from the factory.** Its low cost brings it down to the price of an ordinary battery set. We are so confident that you will be delighted with this wonderful, easy-to-operate **batteryless radio** that we offer to ship it to your home for **thirty days' free trial**—you to be the judge.

Mail This Coupon

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer,** which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis—**WRITE TODAY!**

METRO ELECTRIC COMPANY
2165 N. California Ave., Dept. 622
Chicago, Illinois

Gentlemen:
Send me full particulars about Metrodyne All Electric Radio and your **thirty days' free trial offer.**

Name_____

Address_____

If you are interested in AGENT'S proposition place an "X" in the square →

MAIL COUPON NOW!

METRO ELECTRIC COMPANY
2165 N. California Ave. Dept. 622 Chicago, Illinois

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

An Ace!

New Model
Pocket Ben

The New Model Pocket Ben is an ace among watches!

He's steady, reliable and unusually good-looking. That's why he's so popular.

Sold everywhere for $1.50. With luminous night-and-day dial $2.25.

WESTERN CLOCK COMPANY
La Salle, Illinois

The Shipshape Home

(*Continued from page 116*)

Furniture Blemishes

WHEN the varnished or shellacked top of a dressing table or other piece of furniture becomes spotted with perfume, the marks often can be removed by applying a little alcohol followed immediately by linseed oil. The surface should be polished lightly with a cloth until the alcohol has evaporated.

One method said to be effective for removing the marks of hot dishes on table tops is to rub the surface vigorously with a small pad of cloth covered with butter. Rubbing the white spots with a wet cloth upon which cigar or cigarette ashes have been sprinkled, is another method sometimes recommended.—S. M.

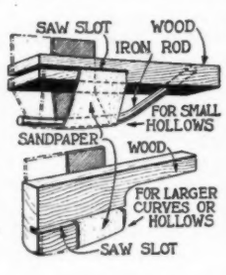
Removing Rust from Nickel

TO REMOVE rust spots from nickel-plated surfaces, apply petrolatum (vaseline) and after several days wipe with a cloth dipped in ammonia. In case the spots are particularly stubborn, add a few drops of hydrochloric acid to the ammonia, but be sure to dry the metal quickly; then rinse it with water and polish thoroughly.—T. H. B.

How to Sandpaper Moldings

ONE of the most tedious jobs when refinishing furniture and picture frames is the sandpapering of the hollows of moldings to a smooth, clean-cut finish. The use of the little devices illustrated simplifies and speeds up this kind of work.

For hollows of small radius, iron rods are bent and attached to hardwood handles ⅞ by 1 by 6 in., as shown. For larger hollows it is simpler to cut the block from one piece of wood. In both cases the working edge is curved slightly from end to end. Practically all the sandpaper surface can be used with these holders except the short piece between the slot and the bottom.—A. M. G.



Two blocks with the paper partly cut off

Enameling Cement Walls

IN FITTING up cellar rooms, it is sometimes desired to give the cement foundation a fine, glossy finish. This can be done if the cement has been well troweled and is reasonably even. Rub the surface with coarse sandpaper until it is as smooth as possible, give it a coat of saturated zinc sulphate solution—about 4 lbs. to 1 gal. water—to neutralize the excessive alkali, and brush on a priming coat of white lead or a ready mixed paint for interior use. Apply one coat of enamel undercoater, a second coat of enamel and undercoater mixed half and half, and finally a coat of gloss enamel.

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Dept. c-s71
Valuable Catalog Free
Send now for big 132-Page Book

Diamonds
GENUINE—GUARANTEED
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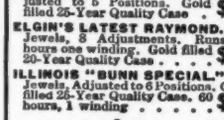
Quality Gifts for All Occasions
The Quality Gift is the most prized of all. Every article we sell is the finest grade. You always get the best value from Loftis. The Diamond Rings shown here are all exquisite creations in solid 18-k White Gold, set with sparkling blue white Diamonds of fiery radiance. Any ring sent for your free examination on request.
Credit Terms: Pay one-tenth down; balance weekly, semi-monthly, or monthly terms at your convenience. All goods delivered on first payment.

RAILROAD WATCHES
Guaranteed to Pass Inspection
HAMILTON NO. 992. 21 Jewels. Adjusted to 5 Positions. Gold filled 25-Year Quality Case . $55
ELGIN'S LATEST RAYMOND. 21 Jewels, 8 Adjustments. Runs 40 hours one winding. Gold filled 20-Year Quality Case $55
ILLINOIS "BUNN SPECIAL." 21 Jewels, Adjusted to 6 Positions. Gold filled 25-Year Quality Case. 60 hours, 1 winding $50

17-Jewel Elgin Watch
Knife and Chain Set
14-k white g.f. 25 Yr. quality case; 12 size; gilt dial; knife and chain to match.
$37.50
$1.00 a Week
Satisfaction Guaranteed or Money Back



Wrist Watch No. 866
14-k white gold. High grade 15-Jewel movement. Fancy corners; $15.00. $1.50 down and $1.50 a mo.
Cushion Strap Watch, nickel, 6 Jewels—high grade leather strap. Special $9.95

WEDDING RINGS
No. 824—The "Ellie" $7.50 solid 18-k white gold . . .
Set with 3 Diamonds, $22.50; 5 Diamonds, $32.50; 7 Diamonds, $42.50; 9 Diamonds, $52.50; 13 Diamonds, $67.50. All platinum, $85. With 5 Diamonds, $50; 7 Diamonds, $65; 9 Diamonds, $80; 9 Diamonds, $100; circled by Diamonds, $[illegible]

Beautiful 136 Page Wholesale Radio Catalog
FREE to Dealers—The greatest book of radio values ever published. Just off the press. Fully illustrated in colors. Battery and All-Electric Sets. New low prices on nationally advertised kits, parts, loud speakers, cabinets, and all accessories. Sensationally low prices on high quality "A" and "B" Eliminators. Wholesale only. Write for this book today.
HAMILTON-CARR RADIO CORP.
711 W. Lake St., Dept. 147 Chicago, Ill.

PLUMBING - HEATING
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SAVE UP TO 40%
Wonderful bargains—everything guaranteed. Full line of plumbing and heating supplies. Hot water, steam heating plants and fixtures and water systems at big savings.
Install Them Yourself
Finest materials all branded and perfect. Tell us your wants and mail us a rough sketch of your rooms.
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"THE SHOOTER'S ART"
Tells how to hold, aim and handle rifles; helps you guide others in correct knowledge of guns. Gives facts that make crack shots. Contains safety and common sense instruction every parent and boy should have. Helps to make boys leaders. Your copy Free. Write at once.
Send Now
The NEW BENJAMIN AIR RIFLE
Outshoots All Others
America's Original Air Rifle
$5 at your dealer's or sent postpaid. Write!
BENJAMIN Air Rifle & Mfg. Co., 629 N. Broadway, St. Louis, Mo.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

FREE 10 DAYS TRIAL

THE NEW IMPROVED INKOGRAPH "PENCIL POINTED PEN" $1.50

The Perfect Writing Instrument

GREATEST VALUE EVER OFFERED

$1000 REWARD

to anybody who can prove that these testimonials were solicited by us.

Inkograph has proven so satisfactory and has elicited considerable favorable comment am enclosing money order, please send me three more. T. J. Trow, Traveling Claim Agent, Joplin, Mo.

The Inkograph fully justifies all claims you make. I own a Waterman but Inkograph is far preferable. Frank R. Sargent, Oakland, Calif.

You have one of the best writing instruments I ever used regardless of price. I use the lowest grade stationery and there is never a blot or scratch because of its round smooth point. It is a wonderful invention. L. H. Orley, Albano, Va.

Oh boy, I am tickled skinny to have the Inkograph, it's a darling. I can now make carbon copies in taking orders and send original in ink to factory instead of a pencled sheet. It surely flows over the paper as if it was grease instead of ink. No trouble at all and a thing I could not do before to trace straight lines very fine and clean. No smear, no muss of any kind. It's just great. E. A. Simms, Jersey City. N. J.

My Inkograph is the smoothest writing instrument with which I have ever written. That is saying a lot. I am a teacher by profession. I have a $7.00 pen and another that cost more than the Inkograph, but Inkograph is better than either. It is the greatest improvement in writing instruments since the Babylonians recorded their thoughts on clay tablets with a triangular pointed reed. John R. Atwell, Chadwick, N. C.

My Inkograph is the first and only writing utensil I ever owned that I can use with pleasure. To be without it for any time would upset my business day. It has always worked perfectly. I have never had any difficulty with it. Arthur L. Fox, Centerville, Mich.

I am a bank teller, have used all kinds of fountain pens but can honestly say for my work I never found a pen so easy and tireless to write. You can pick it up any time in any position and write immediately and all numbers and words will be the same. Try and do it with any other pen. My buddies all agree that it is best for our work. O. R. Morley, Allentown, Pa.

Delighted: It writes bully—you have invented a pen that is perfection. It is so much more rapid than my $9.00 fountain pen. I wish you abundant success. S. L. Carlton, Aurora, Ill.

I am very well pleased with my Inkograph. It is just what I have been looking for. I have had several ink pencils but nothing like the Inkograph; it writes like the point was greased and it makes no difference what kind of paper, it is fine for shipping tags. S. T. Jarrett, Harrisville, W. Va.

The Inkograph is all that you claim it to be. Enclosed find order for two. Robert Heller, Craigville, Pa.

The Inkograph. I am thoroughly convinced, is the best writing instrument I have ever used. It is sure, sane and clean and always ready to use. I am very well pleased with it. J. E. Rampton, Pensacola, Fla.

NEVER before has any manufacturer of a standard writing instrument which is guaranteed to give perfect satisfaction, offered you so great a value. Remember, the Inkograph answers the purpose of both pen and pencil combined. Its point is shaped like a fine lead pencil point and writes with ink free and easy without a miss, skip or blur. The steady uniform flow of ink actually improves your handwriting. Won't blot, scratch, leak or soil hands.

You who already possess a standard fountain pen will find the Inkograph a most valuable addition to your writing equipment, for it will do everything any fountain pen can do and many very important things which it is impossible to accomplish with any fountain pen at any price.

Combines the Best Features

of both pen and pencil, minus the weak points of both, plus improvements not found in either.

The lead pencil smudges, the point breaks and its writing soon is obliterated. Most fountain pens skip, scratch, flood, clog, leak, blot, soil hands and clothing. The old stylographic ink pencil dries up, balks, blots, writes heavy, flows unevenly and is never reliable. The Inkograph feeds as fast and uniform on the 20th page as it did on the first.

Cannot Leak

Not the tiniest drop of ink will spill, although one filling is sufficient to write thousands of words. Will write on any quality of paper.

Makes 3 to 4 Carbon Copies

at one time with original in ink. Bear down as hard as you like without fear of bending, spreading, injuring or distorting its 14 Kt. solid gold point. Are you a salesman?—use an Inkograph, make out your orders in ink and retain a duplicate for your records. Do you wish to keep a copy of your private correspondence? — use an Inkograph. Do you do office work which requires clear carbon copies? — use an Inkograph. Do you make out bills or sales slips?—use an Inkograph and make a permanent original in ink with carbon copies. You can permit any one to write with your Inkograph, for no style of writing can affect the Inkograph point as it will a fountain pen.

SAME SIZE AS $7 & $8.75 FOUNTAIN PENS

Draws Lines to a Ruler

Without smearing, smudging or blurring the paper. Writes with any color of ink.

Requires No Blotter

The ink dries as fast as you write, because the flow is fine, even and uniform.

Patent Automatic Feed

Prevents clogging. No complicated mechanism to clean or get out of order. A year's guarantee certificate with full directions accompanies each Inkograph and is your absolute protection.

An Instrument of Refinement

In appearance, quality, workmanship and material it is the equal of writing instruments which sell for a great deal more. It's beautifully highly polished finest quality of black, hard rubber, its 14 Kt. solid gold point and feed, safety screw cap, self-filling lever and clip make it an instrument of distinctive elegance and refinement. Each Inkograph is designed and finished to please the eye and fit the hand of all.

You Who Are Dissatisfied With Your Fountain Pen

Try the Inkograph—remember, all we ask you to do is try it, for if it does not prove thoroughly satisfactory and if it is not handier and smoother and is not far superior to any fountain pen you ever owned, whether it cost $5, $6, $7 or $8; return the Inkograph to us and we'll refund your money—no questions asked.

Inkograph Co., Inc.
199-11 CENTRE ST.
NEW YORK, N. Y.

That hard smooth round ball-like point, which glides with ease over the coarsest paper and makes possible writing in ink as rapidly as with the softest lead pencil.

Received my Inkograph. Am surprised to know how well I can write with it. The Inkograph is a wonderful little writer, it's my friend now for good penmanship. I am writing this letter with it; can you tell the difference between Inkograph and pen letters? I Can is my answer. C. R. Fuller, Patterson, Mo.

I received my Inkograph with which I am writing this letter. I have purchased at least one dozen ink pencils. Yours seems to be the only one that gives perfect satisfaction. I believe you have solved the problem of the perfect writing instrument. Dr. Richard T. McLaury, Dunkirk, Ind.

The Inkograph is truly the best pen I ever had the pleasure to use barring no price or make of pen, after I take into consideration the high price I usually paid for a Parker, or a Waterman pen, I cannot see how such a low priced pen as the Inkograph can be put on the market and give such unusual service. Harvey L. Winston, Brentwood, Calif.

In making out local requisitions, it is necessary to make an original and two carbon copies on very heavy paper, and the Inkograph does this twice as well as the hardest indelible pencil, and is much neater and the original is much more legible. Wm. L. Fortney, Placerville, Ia.

Your Inkograph is everything you state. It is just wonderful. So send me two more. Arthur Olicott, Tucker, La.

Gave pen thorough tryout. Enclosed find sample of work I have to perform. Have been using pencil. Never got entire satisfaction. Hard pencil makes original too pale and soft pencil makes poor copy. I am highly pleased. S. M. Cooper, Inquiry Division, P. O., South Bend, Ind.

I found the Inkograph all you represent it to be and I was very well satisfied with it. I made a great mistake when I bought the Inkograph, as I did not take out Loss or Theft Insurance on the pen, for the pen is gone. I am writing this to ask that you send me another Inkograph by return mail, charges C.O.D. I can recommend the Inkograph very highly to anyone who needs a pen which will stand up under very hard usage. George B. Moore, Columbia, Fla.

It sure has improved my hand writing—I never took home any medals for penmanship but I can almost read my own writing since I got this pen. M. F. Johnson, Medina, Wis.

I want to thank you for the return of my Inkograph pen, which you repaired for me. I feel rather lost without this pen in my pocket. I prefer it to any pen I ever carried principally because of the ease with which one can write with it, not having to be careful whether you slide the pen to the North, East, South or West, it flows freely in all directions. Wm. B. Brown. New York, N. Y.

Received my Inkograph and same is filling a long-felt want. Kindly send two more of the same style by parcel post collect as soon as possible. Theodore Priestley, Akron, Ohio.

I bought one of your pens a year ago. You sure build the best pen on the market to my notion. Frank R. Ellsworth. Fargo, N. D.

I wouldn't take $5.00 for the pen I am writing this letter with. I have a good fountain pen but don't write any more with it. I am proud of the Inkograph and that I can say this to you and mean every word of it. R. H. Wilson, Beckley, W. Va.

DEALERS

Stationery Stores, Drug Stores, Department Stores, etc., send for our catalog and trade prices.

AGENTS

Sell Inkographs, make bigger profits, more sales, without investment. Quicker commissions, popular prices, no competition. Send for an Inkograph or write for special sales plan booklet.

SEND NO MONEY

Your name and address are sufficient. Pay postman $1.50, plus postage on delivery. When remittance accompanies order, Inkograph will be sent postage prepaid. If within ten days the Inkograph does not prove satisfactory return it and we'll refund your money without further correspondence. It is because we are sure the Inkograph will meet your requirements to perfection that makes it possible for us to make you so attractive an offer.

This Coupon Properly Filled Out Is all that's necessary. Send it today and procure one of the New Improved Inkographs on a 10-Day Free Trial, with no strings tied to it. If you prefer smaller size with ring on cap to be carried on watch chain or ladies' soutoir, mark X here ☐

INKOGRAPH CO., Inc. 199-11 Centre St., New York, N. Y.

Gentlemen: You may send me your Inkograph. I will pay postman $1.50, plus postage on delivery.

Name.....

Address.....

City.....State.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Every Handy Man needs SMOOTH-ON NO. 1

for stopping leaks in steam, water or gas pipes, mending cracks, or leaks in furnaces and boilers, radiators, tanks, sinks, pots and pails, making loose handles tight, tightening loose screws, hooks, locks, door knobs, etc., stopping leaks in automobile engine water jackets, in radiator, hose connections, gas tank and gas, oil and exhaust lines, making a fume-proof joint between exhaust pipe and tonneau heater, keeping grease cups, hub caps and nuts from loosening and falling off, etc. Hardens like iron and stays everlastingly tight.

To make wet cellars dry use SMOOTH-ON No. 7

the one practical waterproofing that you can apply yourself, easily, from the inside, to wet or dry surface and with every assurance of thorough watertightness, even in the wettest seasons. Effective in wet boiler pits, at cracks and porpous spots and also excellent for patching and waterproofing any concrete, brick or stone surface to keep water out or in.

About 25 lbs. of Smooth-On No. 7 are required for each 100 square feet of surface covered, and no experience is necessary.

Write for FREE BOOK

To get perfect results, write to us for and *use* the Smooth-On Repair Book. Free if you return the coupon.

Get Smooth-On No. 1 in 7-oz., 1 lb. or 5-lb. tins and Smooth-On No. 7 in 5-lb. tin or 25, 50 or 100-lb. keg at any hardware store, or if necessary, from us direct.

SMOOTH-ON MFG. CO., Dept. 58,
574 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book.

Name.....

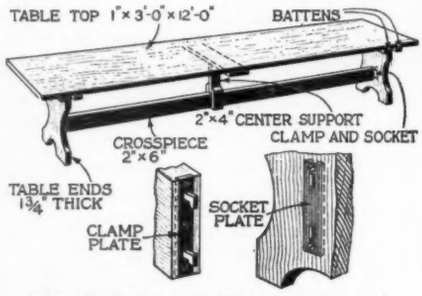
Address.....

10-27 .....

Return this coupon for a FREE copy of Booklet

Bed Rail Joints Used in Making Tables

HERE is a new idea for making knock-down tables for churches or halls where a room is to be used as a banquet or dining room at one time and as an assembly hall at another. Thirty such tables were made recently for a city church from plans originated by the members in charge.



A heavily built dining table, which can be knocked down and stored in a small space

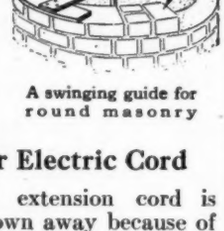
Each consists primarily of a top 3 by 12 ft., end pieces 1¾ in. thick, 2 ft. 3 in. wide, and 2 ft. 4 in. high, and a crosspiece 2 by 6 in. by 9 ft. Battens are placed under the top to form grooves or sockets to receive the end pieces.

The crosspiece and end pieces are clamped together by means of common bed joint fittings such as are used for the side rails of wooden beds. These can be obtained at well-stocked hardware stores. To prevent the table top from sagging, a central support is bolted to the crosspiece.—ESTHER E. REEKS.

Building a Circular Tower

WHILE building a circular stone tower for a water tank, I used the method illustrated to get the masonry round and plumb. A wooden template was made of boards in T-form and pivoted on a 1-in. pipe set in the center of the tower. The upper end of the pipe was braced with three ropes, tied to stakes driven in the ground some distance away.

The template, as it was swung around, gave an accurate guide for laying the stones. —H. JACKSON.



A swinging guide for round masonry

Novel Test for Electric Cord

AN ELECTRIC extension cord is sometimes thrown away because of the difficulty of locating a break in the wires that is concealed by the insulation. A break of this sort can be found by connecting the wires at one end of the cord to the high tension terminals of a Ford spark coil. The other ends of the cord are short-circuited. When the battery terminals of the coil are connected to three or four dry cells arranged in series, a hot spark will jump across the break in the wire and its location can be detected.—W. S. FOGG.

Never before in all watch history two watches as popular as these INGERSOLLS

Yankee $1.50; Yankee Radiolite $2.25; Wrist $3.50; Wrist Radiolite $4.00

Oh, Listen to That College Band!

HERE *they* come! But where are you? Is your own horn glistening in the sun as the band proudly plays the old class songs, or are you far back in the grandstand?

Big times! Good times! All the time! *That's* the program of the college band. QUICK! Buy yourself a King Band Instrument. Get some extra fun and money for yourself.

Musicians, the kind that know, prefer Kings. Quicker to learn on! Easier to play! Built and look like jewelled watches.

Any King Band Instrument sold on easy terms, or sent for ten-day free trial.

Send for our interesting booklet, "Playing in the Band". Let Dad and Mother read it. They will then agree that a band will provide their son with wholesome, profitable fun.

KING BAND INSTRUMENTS

The H. N. White Co., 5237-92 Superior Ave., Cleveland, O.
Please send me free copy of your booklet, "Playing in the Band" and your Handy Reference Catalog.

Name..... Age.....

Address.....

City.....State.....

Construction of Small Alternating Current Motors

By PROF. A. E. WATSON
Brown University

This book contains complete instructions for building small alternating current motors in several sizes. The designs will be found in harmony with those of the very best manufacturers, and they can be worked out by the amateur for making useful instruments.

Fully Illustrated Price, $1.5

POPULAR SCIENCE MONTHLY
250 Fourth Ave. New York C

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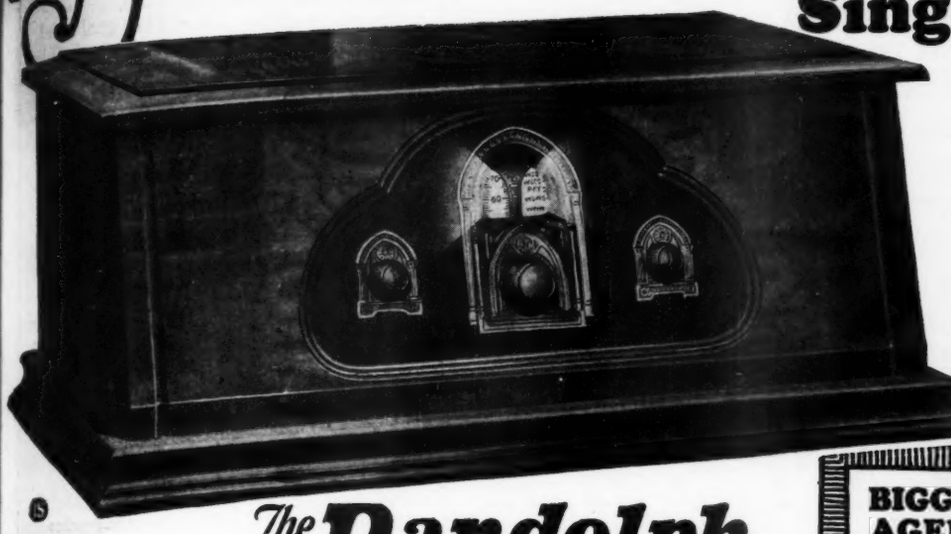
30 Days FREE TRIAL



Single Control 7-Tube

$77

RETAIL PRICE
Completely Assembled

The Randolph
SINGLE CONTROL - ILLUMINATED DRUM

POWERFUL seven-tube radio at factory price. Test it without spending a cent. We claim the Randolph Seven easily equals any radio and we want you to satisfy yourself that it will. To do this, we will send you this powerful radio to try for 30 days. Test it for distance, clearness, ease of operation, tone and every other way you can. Unless it more than satisfies you, return it to us. **Every Randolph set must make good before it is sold.**

Battery or ALL ELECTRIFIED RADIO

The Randolph Seven is sold for use with batteries or connected for operation direct to electric light socket—absolutely batteryless—no chargers or batteries—just **plug in** socket and **tune in.** 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities and leading radio and scientific publications.

Single Control—Illuminated Drum

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a 7-tube tuned radio frequency receiver with power transformers and power amplification. Space wound solenoid coils Full and completely shielded. A real receiver of the highest quality. Tremendous distance, wonderful tone quality, simple to operate.

The Randolph cabinets are in themselves beautiful pieces of furniture made of carefully selected solid burl walnut. Bas-relief bronze escutcheon plates are mounted on the dial panel. In design and appearance it is a cabinet worthy of the high-quality radio it contains. Solid walnut beautifully shaped surrounds the soft verdi-green panel.

Nothing has been spared to make the Randolph Seven the leading radio receiver. We are so sure that it will surpass even your best hopes that we know how safe we are in making the **30 day free trial offer.**

Read What Owners Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas.

I have logged 52 stations from Cuba to Seattle—the set is a world beater.—J. Tampkinson, Detroit, Mich.

Your set is a revelation—has all others tied to the post for distance and selectivity.—Waldo Powers, Vergennes, Vermont.

On strength of its performance sold two more sets this week. T. Scanlow, Orlando, Florida.

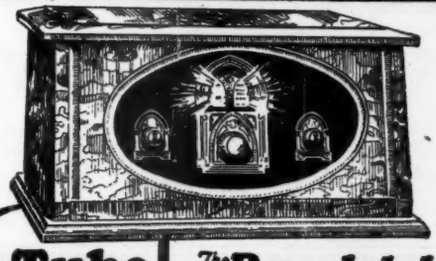
Beautiful Ampliphonic Console Set

Made of the finest carefully selected solid walnut. Two-tone shaded finish. Has built-in cone loudspeaker that compares with any on the market and accurately reproduces high and low notes. Send for the folder today that shows this beautiful console in full colors and gives complete details. **Compares with most table sets in price.** For **battery** or **electrified operation** ready to **plug in** and **tune in.** Write for complete descriptions.

Randolph Radio Corporation
711 W. Lake St. Dept. 115, Chicago, Ill.

BIGGEST DISCOUNTS to AGENTS and DEALERS

WORK either full or part time and make big money. Tremendous advertising campaign helps you sell. Regardless of whether you have ever sold before, be sure to get our proposition. The Randolph sells on first demonstration. Men and women both can make money this easy way. Get your demonstration set for thirty days **FREE TRIAL.**



6-Tube $55 Retail Price SINGLE CONTROL

The Randolph

Now you can have a **new, modern, single-control, six-tube radio.** Do not compare this set with old style 2-dial 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers.

Comes in a beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated Drum with space for logging. Absolutely dependable and very selective. **Sent for 30 Days Free Trial. You test it before you buy.**

Mail Coupon Now

The Randolph Radio Corporation are pioneers in the manufacture of radios. All of its vast and unlimited resources have been used in making and perfecting of the Randolph Receivers. Because of our long and successful experience in the radio business, we are perfectly confident in sending out a Randolph Radio on trial. We know what it will do. Mail us the coupon now for the greatest radio offer ever made.

USE THIS COUPON TODAY!

Randolph Radio Corporation,
711 West Lake Street, Dept. 115
Chicago, Illinois.

Send me full particulars about the RANDOLPH Six and Seven-Tube Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name.....

Address.....

City..... State.....

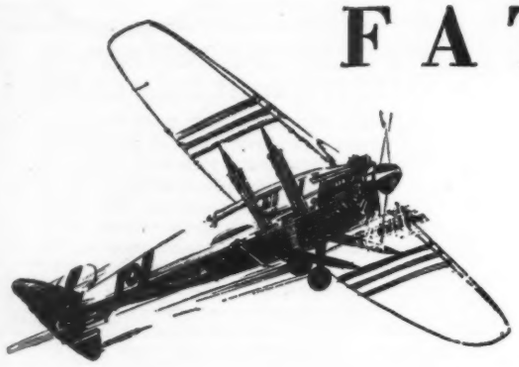
Mark here ( ) if interested in Agent's proposition.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

"ACE HIGH" WITH THE YOUNGER CROWD!

ORDINARILY, this modern generation scorns precedent. History is nevertheless repeating—in a way which we find interesting and gratifying. Something about Fatima—its greater delicacy, its more skillful blending of flavors—has made it, as in other days, an outstanding favorite with the younger set.

FATIMA

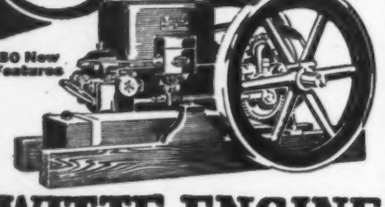


QUALITY *that makes friends everywhere!*

LIGGETT & MYERS TOBACCO CO.

A 2c STAMP —will start you on the road to success. See Money Making Opportunities on pages 150 to 182.

Only $5 Down buys a WITTE Engine
One Year To Pay—No Interest
Lifetime Guarantee



WITTE ENGINE

Write Me Today—for new FREE Witte Book telling how you can buy a WITTE Engine for ONLY $5.00 Down and small EASY Payments. No Interest. Absolutely the greatest engine made. Guaranteed for a lifetime. Used all over the world. Will increase your farm profits $500.00 to $1000.00 a year. Runs on all fuels. Simple, sturdy. Gives most power at least expense. Sizes 1½ to 30 H.P. Engines, also 2-in-1 Saw Rigs and Pump Outfits. Write me today for FREE Book and Easy Terms Offer.

WITTE ENGINE WORKS
2227 Witte Building, Kansas City, Mo.
2227 Empire Building, Pittsburgh, Pa.

PARKS
Manual Trainer
$35.00
without motor

For your home shop! Combination 11-inch band saw and 11-inch wood-lathe. If you have a knack for woodworking you can turn out first-class bridge lamps, cabinets, furniture, ship models, etc., in fast time. Get one

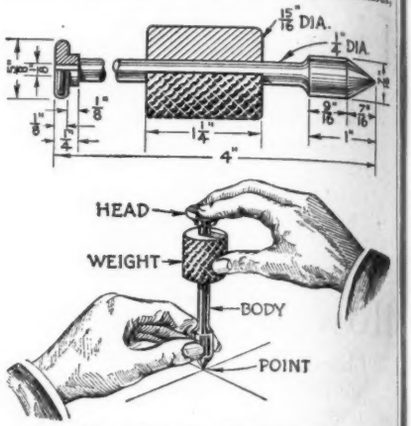
Write for specification circular.

THE PARKS WOODWORKING MACHINE CO.
1547 Knowlton Street Cincinnati, Ohio
Canadian Factory: 208 Notre Dame, E. Montreal, Can.

A Center Punch for Young Machinists to Make

THE semi-automatic center punch illustrated below has proved to be an interesting and instructive project for pupils in high schools and vocational school machine shops to make.

The body of the punch is of tool steel, the weight and head of soft steel. The tools required are hack saw, hammer,



Beginners in machine-shop work can practice many operations while making this useful tool

scriber, center punch, caliper, combination center drill, tool holder, knurling tool, 6-in. steel rule, ¼ and ⅛-in. twist drills and, of course, an engine lathe.

The operations are as follows:

For body—1. Cut off a piece of tool steel 5 in. long. 2. Center ends. 3. Turn 7/16 in. diameter. 4. Turn ¼ in. diameter accurately for 3½ in. in length to fit hole in weight. 5. Rough turn taper, allowing ½ in. to be cut off the end. 6. Turn ⅛ in. diameter for ¾ in. in length. 7. Cut off ends to proper lengths. 8. Chuck in lathe and finish-turn point. 9. Harden. 10. Polish. 11. Temper to medium straw color on point.

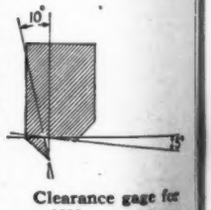
For weight—1. Chuck in engine lathe a piece of 1-in. stock. 2. Face off end. 3. Center end. 4. Turn 1 3/16 in. diameter. 5. Knurl. 6. Drill ¼-in hole 1½ in. deep (on centers). 7. Countersink. 8. Cut off to length on lathe.

For head—1. Chuck in engine lathe a piece of ⅝-in. stock. 2. Face off end. 3. Center end. 4. Drill ⅛-in. hole ½ in. deep (on centers). 5. Countersink. 6. Turn ⅝-in. diameter. 7. Turn 5/16-in. diameter. 8. Round over ⅛ in. diameter. 9. Cut off to length on lathe. 10. Assemble parts together. 11. Rivet head and body together. 12. File top of head smooth where riveted.

This is one of a series of projects which the writer has found particularly useful in school work. Others will be illustrated from month to month.—H. B. KELLAM.

Gages for Milling Cutters

WHEN high-powered, undercut milling cutters are used, the clearance is often a source of trouble because of guesswork in checking it. Small gages for this purpose can be made as shown by laying out the angle—in this case 5 percent clearance on a 10 percent undercut mill—and filing them.—H. J. C.



Clearance gage for milling cutters

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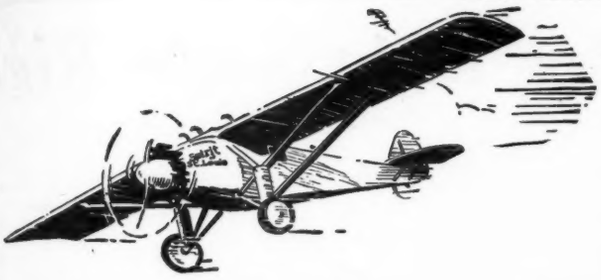

Lindbergh's Own Story

"WE"

Written by
Charles A. Lindbergh

How to Get This Great Book

Charles A. Lindbergh has written the most thrilling book published in years, telling the story of his life as an aviator, and describing in detail his momentous flight from New York to Paris.

EVERY American family will want to own a copy of "WE," because it commemorates the greatest feat in the world's history, and is a souvenir of the most astounding enthusiasm ever aroused by a single human being.

What You Get in "WE"

"WE" would be a wonderful book even if Charlie Lindbergh were not the most famous man in the world today. It tells the dangers, heart breaks, thrills, surprises, conquests of flying, as they have never been told before. It is packed with scores of personal anecdotes that give you a vivid picture of an aviator's actual experiences and feelings. It is all told in a direct, manly style that makes delightful reading.

Read the detailed story of the great flight to Paris; read of the stupendous ovations given him in Paris, London, Washington, New York and St. Louis.

Among the many illustrations are twenty-six full page photographic reproductions of Lindbergh himself:—as a boy with his father, with his famous plane, in the plane, in Paris, in London, in New York,—everywhere—speaking, being kissed by Bleriot, shaking hands with celebrities, facing millions of people with more fear than he ever felt facing death in a parachute drop.

Our Special Offer

We offer to send to readers of POPULAR SCIENCE MONTHLY, the specially bound SOUVENIR EDITION, with gold leaf top, pebbled buckram cover. To get an early copy of this special edition of "WE," you should send the coupon without delay. We will prepay the postage (the book weighs over one pound and a quarter). You need send no money, and can pay the price of the book, $3.00, to the postman, upon delivery (the money-order fee adds only 7c), or you can send us $3.00 with the coupon. But send your order now, while we still have copies.

Send No Money
—just use this Coupon

POPULAR SCIENCE MONTHLY
250 FOURTH AVENUE, New York, N. Y.

Gentlemen:—Send me a copy of the handsomely bound SOUVENIR EDITION of "WE." I will pay the postman $3.00 (plus the money order fee of 7c) on delivery. It is understood that if I am not satisfied with "WE" in every respect you will refund my money.

Name.....

Address.....

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If you prefer to pay cash send $3.00 with this Coupon

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Mr. Adolph Bingler making the "Sovereign of the Seas" from the Popular Science blueprint. Carving tools are an essential in making fine ship models.

A NEW tool for the handy man

HARD jobs are made easier with this new "tool"—a set of London-Addis carving tools. Every man who does odd jobs around his house or likes to make things will find scores of uses for this fine set of inexpensive carving tools. Whether a beginner or an expert at making things you will find in the set illustrated below all the essential carving tools needed.

Chests, bookshelves, chairs, tables and all of the other furniture that is described in the Home Workshop Department of this magazine can be more easily and better made if you have a set of London-Addis carving tools on your workbench.

Ship Model Makers

Men who are building the Spanish Galleon, Viking Ship, (illustrated above) U. S. S. Constitution, or the Sovereign of the Seas will find that they can make their job easier and at the same time get a more beautiful model if they use these tools for shaping and hollowing out the hull, for scoring the deck, for making the small boats, equipment, etc. And for carving the dragon head on the Viking Ship, the prow and stern galleys on the Spanish Galleon, the figurehead, rails, ports, etc., of the Constitution and Sovereign of the Seas a set of good carving tools is essential.

The complete set illustrated consists of a stencil chip carving knife—Arkansas Stone—3/32 inch parting tool—1/16 inch veining tool—⅛ inch deep gouge—¼-inch flat gouge—⅜ inch broad gouge. These tools with the specially designed sharpening stone are packed in a durable kit made of stout brown canvas. The complete set, including the kit and sharpener, is only $4.30.

SEND TODAY the coupon with your remittance for $4.30 and we will ship you the complete kit, **postage prepaid.** If you are not satisfied in every respect we will refund your remittance without argument or delay. Could any offer be fairer?

7-PIECE SET $4.30

Chas. F. BINGLER SONS, Inc.,
182 Sixth Avenue, New York City

Dear Sir:
Enclosed is $4.30 for which please send me by return mail your Kit of famous London-Addis carving tools. It is understood that if I am not satisfied in every particular you will refund my money.

Name.....

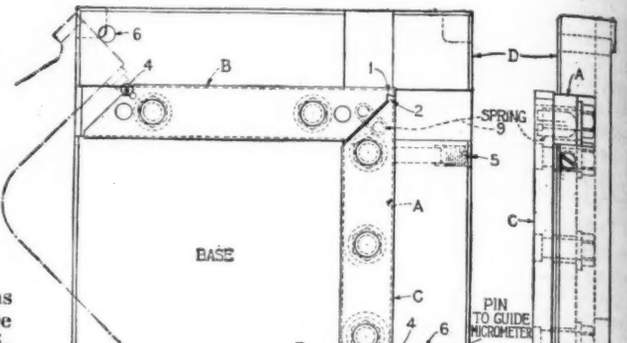
Street.....

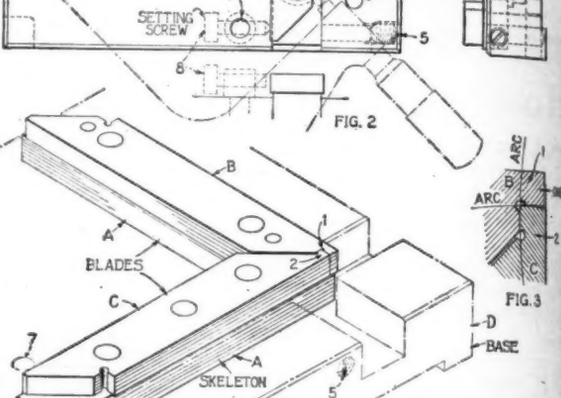
City and State.....

When's a Right Angle *Right?*

(*Continued from page 82*)

lightly in place. Clearance holes are drilled for the cap screws that bind the blades to the skeleton. These holes should be large enough to permit the insertion of a socket wrench from below when setting the instrument. Stop pins 6 are a convenience for guiding the micrometer when setting the blade. Fine adjustment screw 8 mounted in removable holder 7 is a convenience for setting the gage. This is all the work that is required on the base D.





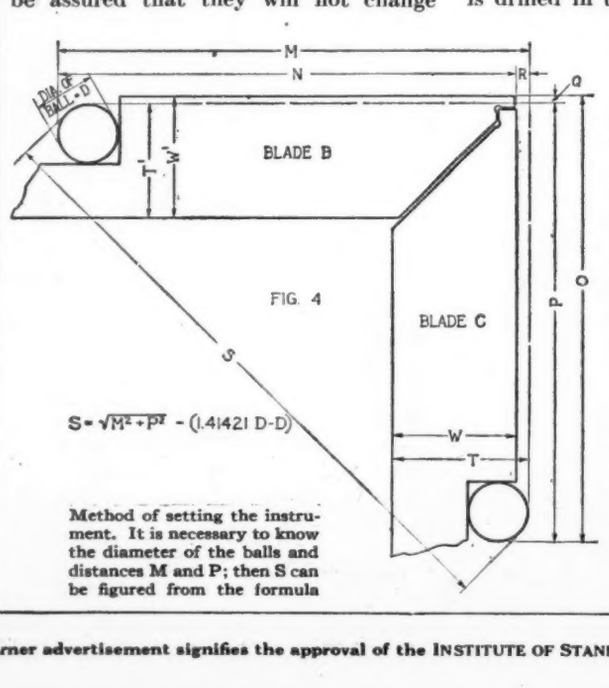
How the gage is made and detail of joint between blades

The skeleton, as has been said, is merely a well finished piece of machine steel which serves to hold blades B and C. Blade B is doweled to the skeleton as well as being held by two cap screws, while blade C is held by the cap screws only. The dowels should not be fitted too tightly, for they might distort even the hardened blade. The screw holes in the skeleton for blade C should be 1/16 in. loose so that the blade is capable of being adjusted.

It is on the blades that most careful workmanship should be used. They should be made of tool steel, hardened, drawn in hot oil at 400 degrees for an hour, then ground and laid away to season for several months before they are finally lapped. In this way one can be assured that they will not change shape. They are made so that they will overhang the skeleton for about ½ in. except at the ends.

The blades should be made as nearly alike in dimension as possible, and should be perfectly straight and parallel. The only really particular work in making the instrument is the lapping of the blade edges straight, square and parallel.

Notches 4, which are to receive the steel balls, are made 3/16 in. square, and for convenience in grinding, a 3/32 in. hole is drilled in the corner of it before the notch is cut. In this way clearance is provided for the grinding wheel. The notches 1 and 2 are the only places where the two blades make contact. In the case of notch 1, the surfaces are perfectly straight and flat, while in notch 2 both surfaces are rounded to an arc having a very large radius as shown in Fig. 3. This may be done with an oil stone.



Method of setting the instrument. It is necessary to know the diameter of the balls and distances M and P; then S can be figured from the formula

In this manner a double line contact is obtained between the two blades. This construction permits the ends of the blades to be moved slightly (all that will be necessary in adjusting the instrument) without measurably in-

(*Continued on page 125*)

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When's a Right Angle *Right?*

(*Continued from page 124*)

creasing the distances N and O. About ten thousandths is ground off the end of the blade B to insure that it will not extend beyond blade C.

When the blades and the skeleton are completed, the cap screws should be screwed in tight and their heads ground off parallel with the opposite face of the blades so that the assembly will lie flat.

A U-shaped spring, marked 9, is bent from 1/32-in. drill rod and properly tempered to maintain the contact between the two blades. A recess is made in the skeleton for the spring.

The 3/16-in. balls shown in the notches are of the finest quality. It is best to preserve the same balls for all tests. They can be held with a bit of hard cup grease in the notches when measurements are being made.

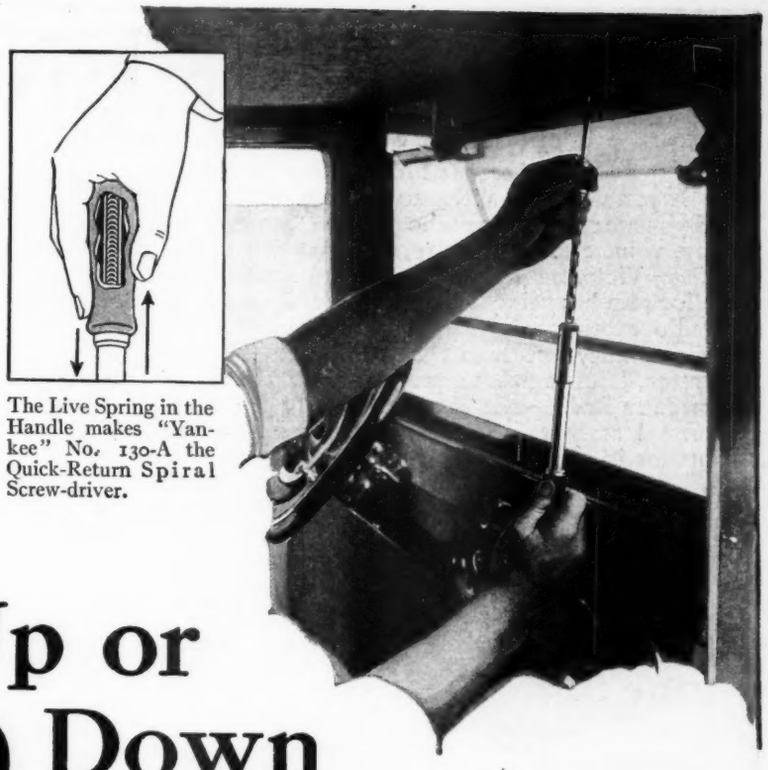
THE setting of the instrument to an exact right angle involves the taking of measurements with micrometers, and the computation of the length of the hypotenuse of the triangle shown in Fig. 4. Referring to this illustration, length S is the one used in setting the instrument. This is determined from the formula shown. It is required to know the diameter of the balls, and the distances M and P. M is the sum of N plus R. R is the difference between T and W. It should be noted that where W is greater than T, their difference, as Q, must be subtracted from N in order to obtain M. This must be done in the case of the leg C, as it is shown in Fig. 4. An attempt should be made to have M as nearly equal to P as possible, and ordinarily T will be slightly greater than W.

Having computed the distance S from the measurements and the formula, all that remains to be done is to set the two blades so that the distance across the balls equals S. Guide pins 6 and adjusting screw 8 are useful at this point. When the blades are set, the cap screws on blade C should be tightened.

If the tool is made with ordinary care, the right angle will be true within 15 seconds of arc, which in a 4-in. try square corresponds to an error of less than three ten-thousandths at the end of the blade.

The writer has found that unless the squares or other articles being examined have provision for adjustment of the blade, it is better not to use the light test, that is, to hold the gage and work against the light, for the error will appear to be magnified. Another point is that unless the edge being examined is rounded, it is better to run a magnifying glass along it, as then it is much easier to estimate the amount of the error.

A convenient size to make the instrument is to have the distances M and P 4.25 in., as then the distance S will be slightly less than 6 in. and a 6-in. micrometer can be used. This size enables squares up to about 6 in. to be checked, and, of course, larger ones, for the straightness of a longer blade is easily established.



The Live Spring in the Handle makes "Yankee" No. 130-A the Quick-Return Spiral Screw-driver.

Up or Down *is the same to* "YANKEE" No. 130-A

In any position driving (or drawing) screws is surprisingly easy and speedy with this world-famous Quick-Return Spiral Ratchet Screw-driver.

The live spring in handle keeps blade in screw slot, and brings handle back ready for the next push—without a second's loss. Great for working one-handed.

Just push! The Spring and "Yankee" Spiral do the work for you, and save your time.

Right-hand Ratchet, Left-hand Ratchet and Rigid. Three sizes of bits: No. 130-A, Standard Size. No. 131-A, Heavy Pattern. No. 135, Light Pattern. "Yankee" Spiral Ratchet Screw-drivers, without the Quick-Return feature, No. 30-A, No. 31-A, No. 35.

Some other "Yankee" Tools: Ratchet Bit Braces, Ratchet Breast and Hand Drills, Automatic Feed Bench Drills, Automatic Push Drills, Plain Screw-drivers, Ratchet Tap Wrenches, Vises with removable base.

Dealers Everywhere Sell "Yankee" Tools

"Yankee" on the tool you buy means the utmost in quality, efficiency and durability.

Write for Free "Yankee" Tool Book

This interesting little book is for all lovers of fine tools. It tells just what you want to know about all the famous "Yankee" Tools for making work easier and quicker.

NORTH BROS. MFG CO., Philadelphia, U.S.A.

"YANKEE" TOOLS

Make Better Mechanics

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VICTOREEN

Dependable Standardized Super Parts

Accepted as the Best in Radio

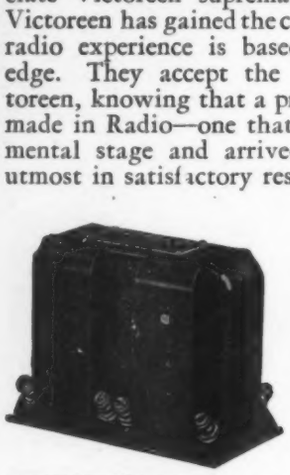
If you want the ultimate in radio reception—if you are one of those who demand range, clarity, volume and selectivity, then you will appreciate Victoreen supremacy in the super field! Victoreen has gained the confidence of those whose radio experience is based on scientific knowledge. They accept the new products of Victoreen, knowing that a progressive step has been made in Radio—one that has passed the experimental stage and arrived at the point of the utmost in satisfactory results.

Victoreen Radio Frequency Transformers

No. 170—For Storage Battery Tubes.
No. 171—For Dry Battery Tubes.

The very heart of the Super Circuit! These units are instruments of great precision, being matched and tuned to within one-third of one per cent and eliminating the necessity of tube matching.

Price $7.00



Victoreen 112 Audio Transformer Unit

Designed to handle up to 400 volts of B battery supply, this unit is especially adapted to the Western Electric cone speaker or similar types. The transformer consists of two stages of Audio amplification in one case and is designed for use with two 112 power tubes.

Price $22.00

Send today for 1928 Blue Print of Victoreen Circuit

Makers also of the famous Victoreen Long Wave Super Coils, Master Control Units, Rheostats and Audio Control Units.

SUPER QUALITY RADIO PARTS

The GEORGE W. WALKER Co.

MERCHANDISERS OF VICTOREEN RADIO PRODUCTS

2825 CHESTER AVENUE CLEVELAND OHIO

IS

BUILD!

THE MOST POPULAR KIT SET

BROWNING-DRAKE in 1924 gained an unprecedented popularity that has never waned despite the fact that countless designs for home construction have come and gone since that time.

The Official **BROWNING-DRAKE** Kit Set, which incorporates minor refinements to take care of present day broadcasting conditions, is now standard. Essential building instructions with every kit. Get the genuine parts and BUILD your BROWNING-DRAKE TODAY!

DEALERS

Almost three times as many BROWNING-DRAKE parts are sold as those of the nearest competitor. If your jobber cannot supply you, write or wire us TODAY.

BROWNING DRAKE CORP.

Cambridge, Mass.

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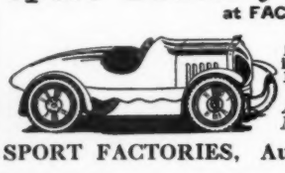
BROWNING DRAKE

Sport Bodies for Fords

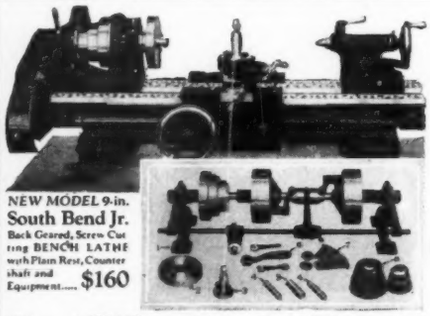
at FACTORY PRICES!



This Model in Grey Prime **$39.50**

Write for Booklet A-10 Showing Other Models.

SPORT FACTORIES, Aurora, Illinois



NEW MODEL 9-in. **South Bend Jr.** Back Geared, Screw Cutting BENCH LATHE with Plain Rest, Countershaft and Equipment..... **$160**

Has All These Practical Features

Back Geared, Six Spindle Speeds; Power Feed. ¼-inch Hole in Spindle, Plain or Graduated Compound Rest; Cuts threads 4 to 40 per inch. Built in 2½, 3, 3½, 4 and 4½ foot bed lengths. A precision lathe, weight complete, 375 lbs. Lathe can be equipped with Motor Drive, operated by ⅛ H. P. Reversing Motor that plugs into an ordinary lamp socket.

FREE—*New Booklet*

24-page booklet, No. 22-K, dealing exclusively with the 9-inch Junior Lathe. 150 photographs Mailed free to any address. Write for your copy today

South Bend Lathe Works
839 East Madison Street
South Bend, Indiana

IS

Time Payments if Desired

Old Bill *says—*

FIVE general kinds of fits are in common use—the running fit, the push fit, the driving fit, the force fit, and the shrink fit. Stop to think when you are making any of these fits and avoid a misfit. Mr. "I Didn't Think" has no business in a machine shop.

Excuses and alibis are all alike. They don't get anyone anywhere, especially in the shop. Don't make excuses, but demonstrate.

Good mechanics never slight small details.

The first step on starting a new job is to think of the quickest and easiest way to do it; second, be sure you're right; third, go ahead!

A wrench never should be used for hammering. That may weaken the wrench and be the cause of an accident later on when it is used to tighten nuts.

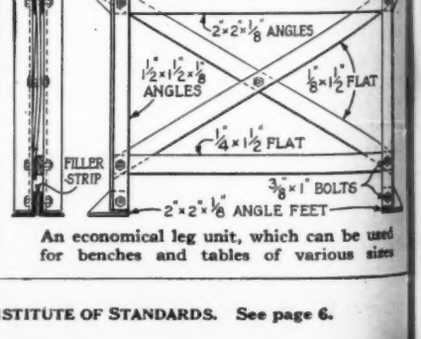
A good machinist is a good sport and quite willing to go after hard jobs. He knows that once he masters a hard job, ordinary tasks will seem quite simple and easy.

In choosing the method of doing any job, take into consideration the tools available, the accuracy required, and the number of pieces to be made.

Mechanics get ahead faster with their work by following the line of least resistance in connection with every job. This means to do things the easiest, quickest and most economical way.

Light Angle Irons Make Neat Legs for Benches

FOR benches and shop tables of varying width and height the writer uses with success a standard bench leg made of angle iron as shown. Only six ⅜-in. bolts are required for assembling each leg. The angles and flats are cut to length and punched or drilled with 7/16-in. holes. The sizes given will be strong enough for all but the heaviest work. —FRED FISHER.



An economical leg unit, which can be used for benches and tables of various sizes

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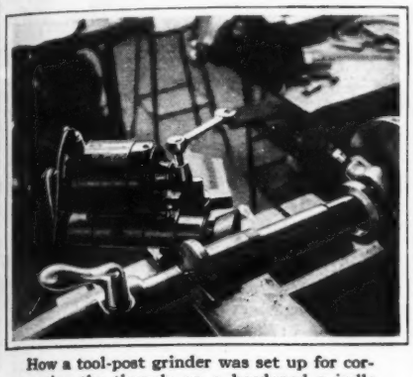
Grinding Threads on a Lathe

By O. S. MARSHALL

A COSTLY piece of work sometimes is seriously damaged because of a poor thread. The stock may be of such a nature as to make the production of a satisfactory thread practically impossible, or, if the part is to be hardened, as in the case of the particular job illustrated, the process of heat-treating may so distort the threads that they must be corrected.

In this instance the part to be corrected was a hardened spindle for a milling machine. The threaded part is for the rear thrust bearing, the nut for which is seen at the right on the spindle. The



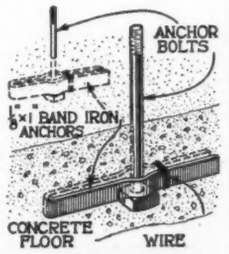
How a tool-post grinder was set up for correcting the threads on a hardened spindle

threads had become so distorted that the collar ran out .005 in.

The grinding set-up for making the correction on an engine lathe is shown clearly. A cup wheel with a 30-deg. taper was used. It was carefully dressed with a diamond on that face and also on the front. The compound rest was set to the two required angular positions for truing, the diamond being clamped against the faceplate of the lathe. The grain and grade of wheel for this sort of work should be about 60 to 80 grain, preferably the latter, or even finer, and the grade M or N, or the equivalent. The wheel should be trued carefully by working the wheel from the periphery toward the arbor of the grinder to avoid crumbling at the very edge. It is advisable also to set the grinder in the tool post so that the compound will be set at approximately 30 deg., thus making it easy to "pick up" the lead without having to rely upon setting the driving dog too carefully.

How to Make Anchor Bolts for Use in Concrete

ON A job remote from any hardware store it became necessary to place some bolts in a concrete form. The only bolts we had were too short to bend over, so we bent and fastened strap iron around each.



A strap iron anchor is fastened to each bolt

It's in This Tube, Men

The supremacy we do not ask you to believe until you've proved it for yourself.

A 10-SHAVE TEST OFFERED FOR THE COUPON

GENTLEMEN:

Ask your druggist, and he will probably tell you Palmolive Shaving Cream is his fastest seller.

Countless men have written praising it; sales figures are amazing. Our years of experimenting have been crowned with success. We believe we will win you, too.

But before we ask you to *buy* a tube, we wish Palmolive Shaving Cream to prove its own case on your beard. Hence we offer a 10-shave test, free. Just use coupon.

* * *

Sixty years of soap study stand behind our laboratories. 130 formulas were tried before we succeeded in this unique creation. 1000 men had told us what they sought—5 things a shaving cream should accomplish. They set our goal.

What we have accomplished is in the trial tube we send you. The unvarying qualities that have won men by the millions. If we win you, you'll thank us for the test. If not, return to what you've been using.

Test These 5 Improvements

1. Multiplies itself in lather 250 times.
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face.
4. Strong bubbles hold the hairs erect for cutting.
5. Fine after-effects due to palm and olive oil content.

Ask for this free test. Shave 10 times and *learn* why men adopt it. *Words* can't win men to quit their former shaving cream for this.

Make this test yourself. Cut out the coupon to remind you.

THE PALMOLIVE-PEET COMPANY, CHICAGO, ILLINOIS

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream. There are new delights here for every man. Please let us prove them to you. Clip the coupon now. 3731

10 SHAVES FREE

and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1403, Palmolive, 3702 Iron Street, Chicago, Ill.
Residents of Wisconsin should address Palmolive, Milwaukee, Wis.

.....

.....

Please print your name and address

WHITTLING'S A LOT OF FUN

Professional carpenters have found that Remington Pocket Knives stand up best under hard service. Their blades are of fine steel, evenly tempered, with lasting, razor-sharp edges.

Amateur carpenters will do well to follow the professionals in choosing a knife. And whether or not you consider yourself an amateur carpenter, you'll find a lot of fun in carving with a knife that is keen enough to do delicate work surely and easily. Remington R-4223, illustrated here, is one of many useful patterns that your hardware dealer will show you.

Buy a Remington knife today and learn the fascination of whittling with a knife that cuts. Write for a circular on Remington Carpenter's Knives.

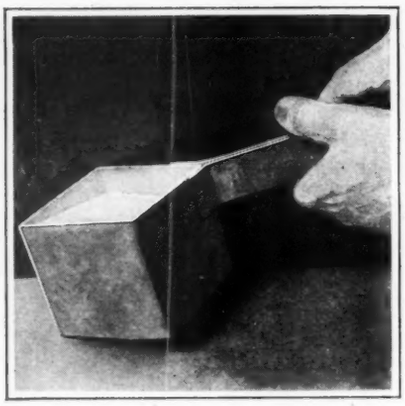
REMINGTON ARMS CO., INC.
Established 1816
Dept. 10-PS, 25 Broadway, New York City

Remington

© 1927 R. A. Co.

Square Ladle for Pouring Molten Babbitt Metal

ON MANY occasions when melted babbitt or lead is used in the shop, it is convenient to be able to pour the metal from either side of the ladle or from the front. Any mechanic can make a ladle



The corners of the square ladle serve as spouts for pouring in three directions

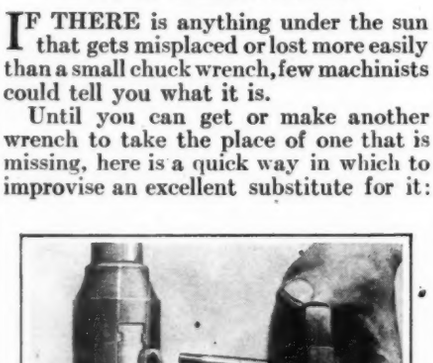
that will do this simply by attaching a handle to a square metal box. The corners of the box form ideal pouring mouths from all three positions.

I melt the babbitt in an ordinary ladle and then pour it into the square ladle illustrated. The handle is made of flat steel, which is bent double, flared out at the end, and brazed to the box.—A. K.

Old Tap and Valve Handle Used as Chuck Wrench

IF THERE is anything under the sun that gets misplaced or lost more easily than a small chuck wrench, few machinists could tell you what it is.

Until you can get or make another wrench to take the place of one that is missing, here is a quick way in which to improvise an excellent substitute for it:



In an emergency, a chuck wrench may be made from a discarded tap and a handle

Get one of those small taps, the square of which fits the socket hole of the chuck. Stick the threaded portion of the tap through the square of a valve stem wheel, lock it with two nuts that fit the tap, one on each side of the wheel, and there you are. It does the work and is not so readily lost as the smaller angle wrench or T-wrench.—F. B.

POWERIZER

Reg. U. S. Pat. Office

Makes Your SET A De Luxe ELECTRIC SET!

POWERIZER will give any set the famous POWERIZER tone and faithful reproduction—obtained by UX210 for the last stage—PLUS genuine, complete ABC elimination by using UX226's and 1 UY227, the new AC tubes. POWERIZER gives a tone to any set that is equal to that in expensive deluxe sets and the finest electric phonographs. POWERIZER strikingly improves the tone quality and when needed, gives ample volume for dancing, concerts, etc.

Model PXY—Radiola—20, illustrated above, is for the Radiola 20. Uses no batteries, liquids or paste. Made complete in a compact, beautifully finished container. Draws between 40 and 50 watts only when set is on. Uses 280 Radiotron as rectifier and 210 as amplifier. List without tubes, $59.00; with UX280 and UX210, $73.00. (3 UX226's, 1 UX227, $15.00.)

Model PXY—A.K. is for the Atwater-Kent. List without tubes, $60.00; with UX280 and UX210, $74.00.

There is a POWERIZER for every set . . . YOUR set. HEAR it TODAY! Your dealer will gladly demonstrate POWERIZER in your home on your own set.

Write for descriptive Literature Today

Jobbers and Dealers

Write us TODAY for folder 1009-PS, "Real ABC Socket Power with Real Tone." It contains much information that will make money for YOU this season.

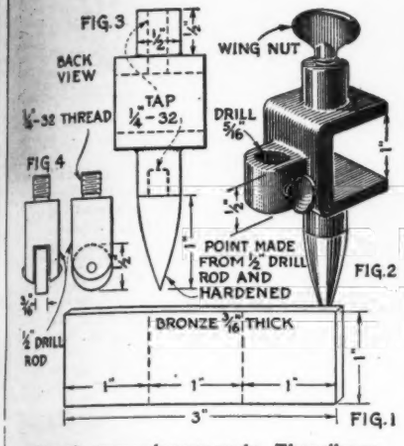
Licensed by Radio Corporation of America and Associated Companies.

Radio Receptor Co., Inc.,
106 Seventh Ave., New York City

Heavy Trammel Points for Large Layouts

WHEN a search of the hardware stores failed to locate a pair of heavy trammel points, we decided to make a pair in the shop. The construction is illustrated.

The points were made to fit a 1 in. square wooden bar. The frame was made of a piece of bronze 3/16 in. thick and 3 in. long. This was bent on the dotted lines, as in Fig. 1. The bosses



How the trammels were made. The roller replaces one of the points when a pencil is used

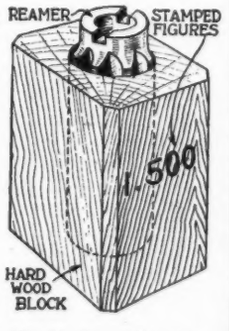
shown in Fig. 2 were made from short pieces of bronze rod and brazed on with silver solder. They were drilled after being brazed on. The points, Fig. 3, were made of drill rod and hardened.

The boss at the back, Fig. 2, was put on only one of the trammel points; it is for holding a pencil or a soapstone crayon. The roller shown in Fig. 4 was made to go in the place of the point whenever a pencil was used; its purpose is to prevent the pencil from wearing too fast.

The complete points were polished and lacquered.—A. S. JAMIESON.

How to Protect Reamers from Damage in a Tool Crib

REAMERS should be handled carefully and protected from the rough usage sometimes accorded other tools. In one large tool crib, each reamer is kept in a holder of the type illustrated. It is a solid block of hard wood with a hole a little larger than the reamer and long enough to cover the cutting edges. The size is marked on one side with large steel stamps and the figures are afterwards blackened with ink or paint. The outside dimensions can be made uniform for all sizes of reamers up to 1 in. and another standard size will serve for larger reamers.—H. L. W.



Simple type of reamer guard made of wood

The Most Important Tool in Your Kit

A Carborundum Combination Stone

TAKE a tip from such experienced workmen as the carpenters and pattern makers—they know the value of properly sharpened tools.

No tool kit is complete without a Carborundum Combination Stone. It quickly puts an edge on any tool—an edge that stays keen longer. Made of Carborundum, the manufactured abrasive—harder, sharper, faster cutting than any other material. It *cuts* the edge on the tool.

The Carborundum Combination Stone possesses a "double duty" feature; one side is coarse grit to start the edge, the reverse fine grit to perfect the edge. Every stone uniform in grit and grade. Does not readily fill nor glaze over. Use dry or with oil. Made in several sizes.

HARDEST AND SHARPEST — REG. U. S. PAT. OFF.

Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.

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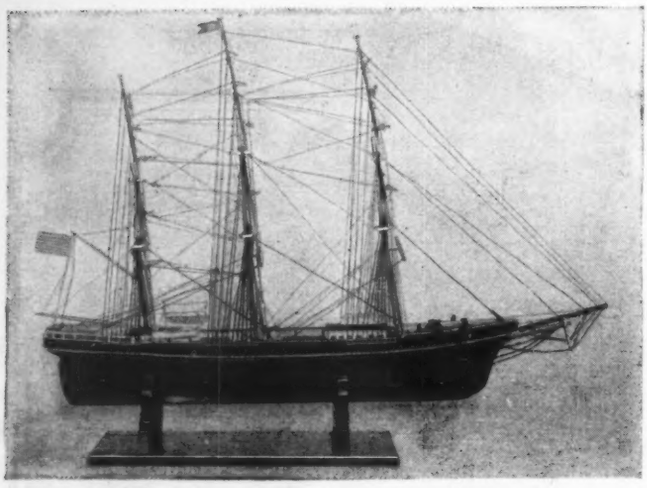
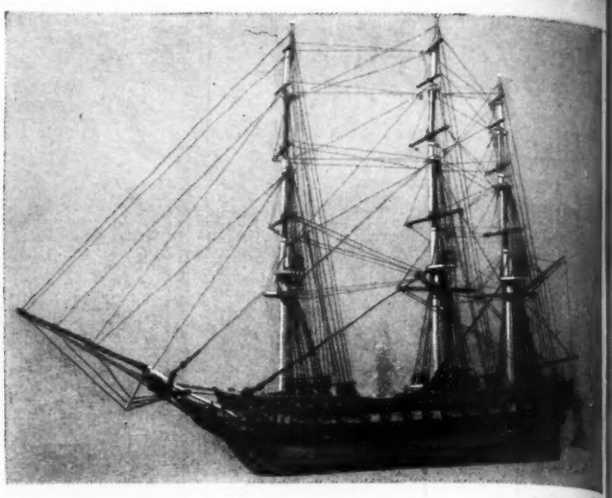
ABRASIVE PRODUCTS

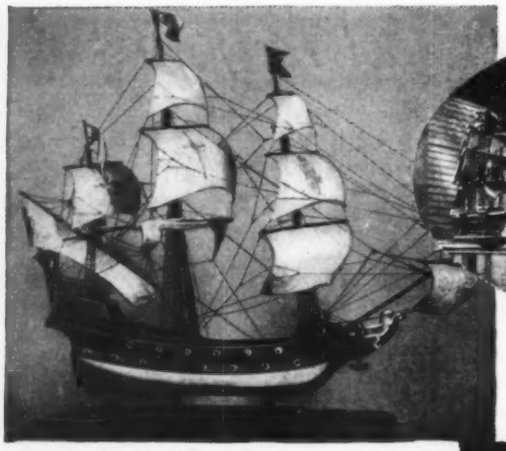


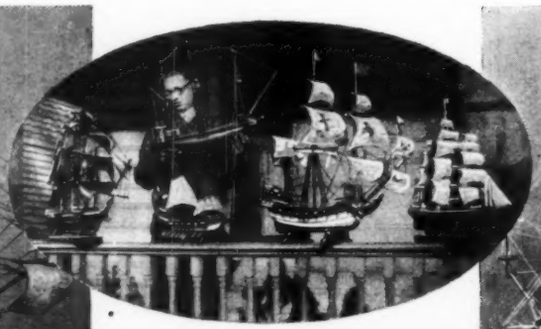
Scale model of the clipper ship, *Sovereign of the Seas*, built by John Nichols, of New Rochelle, N. Y., from the plans given in Blueprints 51, 52 and 53. The hull is 20 in. long

Ship Models Built with Aid of Our Blueprints

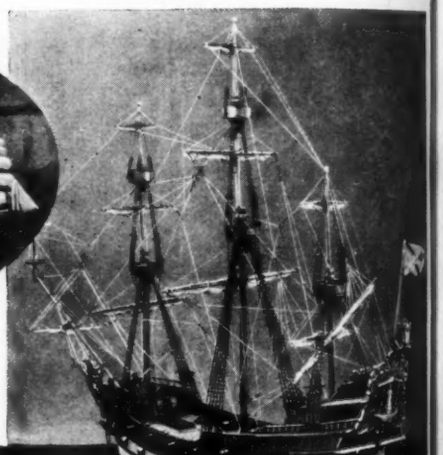


"Old Ironsides" in miniature. This decorative model of the U. S. S. *Constitution* is the work of Rolan B. Miller, Washington, D. C. (from Blueprints 57, 58 and 59). The hull is 19 in. long





Laurence E. Cashbaugh, of Zanesville, Ohio, and his son Ralph, 15 years old, have constructed every one of the blueprint ship models listed on page 102

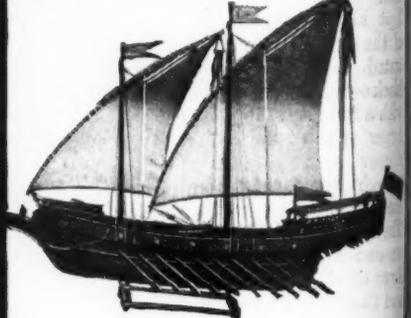


This Spanish galleon, with hull 20 in. long, is the work of William Deppermann, of Orange, N. J. Like the other ships on this page, it was designed by Capt. E. Armitage McCann, noted authority on marine models, especially for POPULAR SCIENCE MONTHLY (see page 102)

Pirate galley (Blueprints 44 and 45) made by Charles A. Modeer, of Astoria, Ore. Mr. Modeer also constructed a model of the galleon with small figures to represent the crew. "The galleon may be made for $5," he writes, "but I will not sell my own for $1,000"

The touch of an artist's hand is seen in this ornate galleon model, which was built by C. V. Czechowski, of Cleveland, Ohio. He has since built the clipper ship

George M. Winemiller, of Great Neck, Long Island, N. Y., who is a photographer, built this magnificent model of the galleon

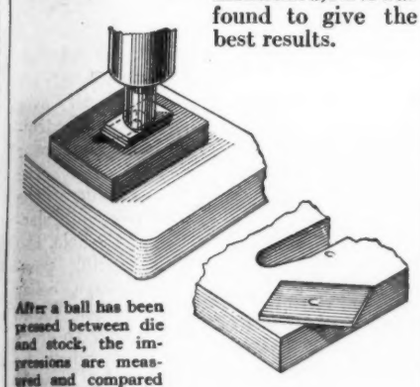


Another pirate model, built by E. K. Brubaker, of Berlin, Pa. He also has built a second model—the galleon. Indeed, our readers have done such wonders in model making that we could fill page after page with interesting photographs

Testing Dies for Hardness

THE working hardness of a die may be checked without the use of a hardness testing machine or any tools other than an ordinary screw press. The writer used the method to be described on blanking dies which were required to punch hard, cold-rolled crucible sheets. Because of the heavy demands upon the tools, it was necessary to develop a definite combination of hardness and strength. For this reason it was found desirable to supplement the usual file tests with something more definite and measurable.

The method is based upon the well-recognized fact that a cutting tool, to give proper service, must be a certain number of times harder than the metal it is to cut. For ordinary conditions, this hardness ratio is assumed to be between 3:1 and 4:1. In the case of the material mentioned, 3.5:1 was found to give the best results.



After a ball has been pressed between die and stock, the impressions are measured and compared

The test is made by compressing a steel ball between the die and samples of the material, and comparing the area of the indentations thus obtained. Those portions of the die which it is intended to examine are polished with emery cloth. The die is placed upon the bolster plate of the press and the steel ball is stuck on by means of a daub of cup grease. Small squares of the material to be worked—enough to make a thickness of about 3/16 in.—are placed on top of the ball. A pressure of between two and three tons is applied through a squared and hardened punch of some sort.

With the help of a strong magnifying glass and a fine scale, the diameter of the impressions is measured. The proportion between their areas is the ratio of the hardness between die and sample.

It is best to use a 10 mm. ball and a metric scale in the tests, as in that case the ratio can be obtained without calculation directly from the Brinell hardness table in any toolmakers' or machinists' handbook. If, for instance, we find the diameter of the indentation in the sample to be 3.75 mm. and that in the die 2.10 mm., then by dividing the hardness numerals corresponding to these figures in the table by each other, we obtain the ratio we want. The numeral for 2.10 mm. impression is 857, and that for 3.75 mm. is 262. (*Continued on page 132*)

TRADE YALE MARK

She just knows they'll be safe in a Yale-locked closet

A YALE LOCKED CLOSET—such an inexpensive, yet sure way of protecting personal property!

We Americans are away so much—motoring or yachting; at the theatre or the club; that we simply *must* have Yale protection.

Your silver and jewels, your furs, your cigars, your valuable papers—put these behind a Yale Deadlock or Deadlatch and you'll know they'll be guarded every moment of your absence.

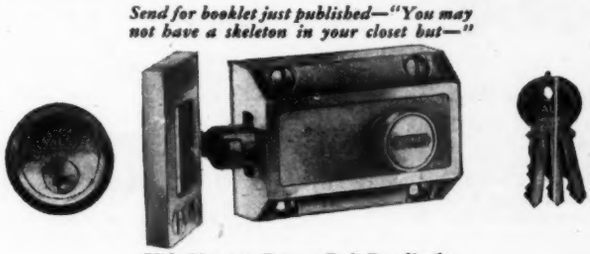
Yale features several distinct types of auxiliary locks for home-closet use—

Yale No. 42RB and No. 042RB Deadlatches
Yale No. 44RB Automatic Deadlatch
Yale No. 2F Deadlock
Yale No. 10F Steel Bar Deadlock
Yale No. 193 Rotary Bolt Deadlock
(the one pictured below)

Each one of these offers effective modern improvement over the ordinary lock—the *safe* over the *unsafe*.

Go, yourself, to a hardware dealer who has the Yale line. He will advise you and help you select the right lock for installation on your Yale Locked Closet. *Printed directions for applying packed with each lock.*

Send for booklet just published—"You may not have a skeleton in your closet but—"



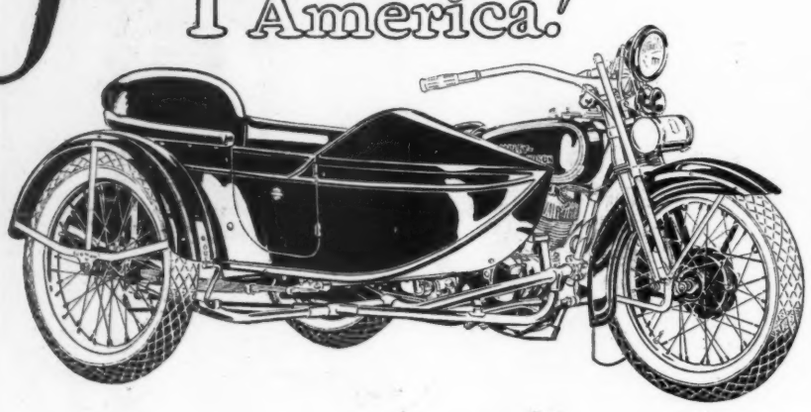
Yale No. 193 Rotary Bolt Deadlock

The Yale & Towne Mfg. Company
Stamford, Conn., U. S. A.
Canadian Branch at St. Catharines, Ont.

YALE MARKED IS YALE MADE

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Fore-wheel brake 1st time in America!



THE most advanced models in the history of the motorcycle industry, with improvements that are being talked about from coast to coast.

Outstanding feature for 1928 is the Fore-Wheel Brake—*doubled safety*. Other improvements are: Throttle controlled motor oiler—air cleaner—positive gearshift lock gate.

Greater stability! Increased safety! Longer life! Streamlines that make each model a beauty! Five minutes in the saddle will convince you that this is the mount you have been looking for.

No increase in prices. Solo Twins as low as $310 f. o. b. factory. See your local dealer. Send coupon for catalog.

and 6 other *new features* in the 1928 MODEL

New Model Sport-Solo Twin

Face-setter for 1928! Has all the new features of standard Twin and in addition has smaller wheels—25" x 3.85" balloon tires—roadster handlebars. Dow-metal pistons, racing type, optional at slight increase in price. The ideal solo mount—wonderfully smooth acceleration and even flow of power.

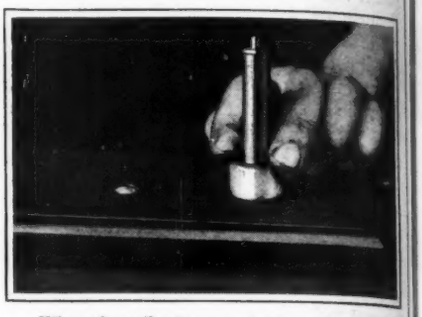
HARLEY-DAVIDSON MOTOR CO.
DEPARTMENT P.S. MILWAUKEE, WIS.

HARLEY-DAVIDSON
Motorcycles

HARLEY-DAVIDSON MOTOR COMPANY
Department P.S., Milwaukee, Wis.
I want to know all about the new 1928 Harley-Davidson Twins. Send catalog and full details.
Name.....
Address.....
City..... State.....

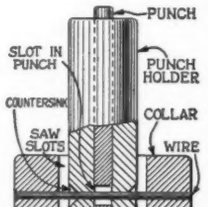
Self-Centering Punch for Use with Templates

WHEN a sheet iron template is used for laying out work, it is common practice to scratch around the hole and then find the center with dividers. A self-locating center punch that saves this work by automatically finding the center of the holes, is illustrated below. The construction and operation of the tool is made clear in the drawing.



When the collar is pressed down, the punch automatically centers itself over the hole

The punch holder is rounded on the end, and tends to center itself over the hole in the template. The collar insures that the punch holder will be held perpendicularly over the hole. The wire spring passing through collar and holder forces the holder to enter the hole when the collar is pressed down, as shown in the photographic illustration. The saw slots and the countersink are merely to give some clearance for the bending of the wire.



How punch, holder and collar are made

For severe service all parts should be of tool steel, hardened.—H. MOORE.

Testing Dies for Hardness

(*Continued from page 131*)

so that the ratio is 857 : 262 = 3.27 : 1.

It should be clear that while the ratio or comparative hardness of die and sample can be accurately computed in this way, each indentation by itself is meaningless so far as the Brinell hardness is concerned, as no standard pressure is used in making the test in this form.

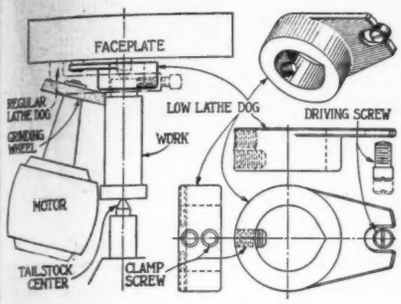
By repeating the test in several places near the cutting edges, a clear picture of the hardness of the die is obtained. As the work a tool has to do is the only reason for the tool, there can be no more logical procedure than this testing of tool against material.

While the proper hardness ratio will no doubt differ somewhat with the kind and thickness of material used, there is no question that there is a certain ideal ratio in every case. By taking dies which have performed well, and testing them each against the type of stock it has had to cut, it is not difficult to establish this ratio.—H. S.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Special Lathe Dog Hugs Faceplate

IN GRINDING work between centers on the lathe, it is often difficult to get near the live-spindle end of the part because the dog is in the way and would strike the wheel, which as a rule must be set at an angle. On long work it is sometimes possible to reverse the part, but this is out of the question on shorter work and undesirable even in many cases where the part is long enough and can be driven from the other end. So the matter usually winds up with some makeshift, like the use of an oversize wheel, which becomes doubly dangerous



Space-saving lathe dog which is a valuable aid in grinding work close to the faceplate

by reason of its excessive surface speed and the necessity of removing the wheel guard to make room for it.

After many experiences of this kind, the writer designed the special dog illustrated. It can be made from a scrap block of machine steel and, when case-hardened, becomes an article that will last a lifetime.

The shortness of the arm is made possible through the use of a driving arrangement different from that of the regular dog. The arm is provided with a slot that is engaged by the head of a screw located below the range of the driving slots near the hub of the faceplate. By having screws of different lengths of head, the dog can be set out from, or back close to, the faceplate as the conditions of the centers may require, without the head of the screw ever extending appreciably beyond the face of the arm.

In placing the hole for the driving screw in the faceplate, it should be located so that the screw will be near the bottom of the slot in the arm when the opening in the dog is centered; this leaves the range of the slot for work of smaller diameters.

There are two screw holes. Of these, the front one is, of course, more important, though the other will prove serviceable if, for instance, the dog is to be used for turning and it is desired to double-clamp the work.—H. S.

WHEN the handle of an ax breaks, the wood left in the eye can be removed by drilling a hole through it and making four radial cuts outward with a hack saw. This quarters the wood so that it can be driven out without difficulty.

Painting The Clouds With A Gun . . .

Judging from the latest newspaper reports, it will not be long before huge guns are entertaining us by painting vividly colored pictures on the sky.

Inventive minds and painstaking research are producing marvelous things in this fast stepping mechanical age.

The same type of mind and the same kind of research are constantly making improvements in our sharp cutting, durable files.

Here are some of the things NICHOLSON Files will accomplish for you—sharpen edged tools, fix locks that stick, clean electrical contacts on your automobile.

These are only a few—other uses are described in our booklet "Files and What They Will Do For You." Send for a copy. It's free on request.

NICHOLSON U.S.A.

—A File for Every Purpose

NICHOLSON FILE COMPANY Ⓢ
Providence, R. I., U. S. A.

Maydole

for men who appreciate fine tools

Pick up a Maydole Hammer and you will know instinctively that it is worthy of a place among your finest tools.

Maydole is just the finest hammer that eighty-four years of specialized skill and experience can fashion from press-forged tool steel and clear, second-growth, air-dried hickory—*all* hammer.

If *you* really appreciate fine tools, you will be completely satisfied only with the genuine Maydole Hammer. Ask your dealer to show you a Maydole, any style or weight. And ask us to send you a free copy of useful Pocket Handbook 23 "B."

YOUR HAMMER SINCE 1843

Maydole Hammers

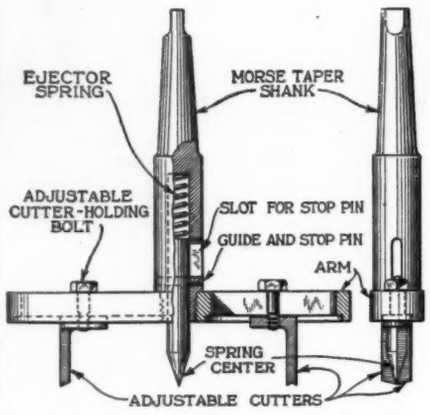
The David Maydole Hammer Co. Norwich, N.Y.

911

Speedy Tool for Boring Large Holes in Wood

DUST guards on the journal boxes of electric car trucks, such as those used in New York subways, are made of soft wood ½ in. thick. Each of these must have a hole from 4 to 6 in. in diameter accurately cut to fit the axle. In making these in quantities, the boring of the hole was the most difficult job until the tool shown was developed.

There is a shank to fit the drill press spindle, which carries at its lower end an



A tool designed for boring holes from 4 to 6 in. in diameter in wooden dust guards

arm having slots for two cutters. These cutters are made of carbon steel, hardened and tempered, and are adjustable for different sizes of holes. One of them is set to cut the outer edge of the hole to size while the other removes the material in the groove. The arm is graduated on the under side for quickly setting the cutters.

The center is backed up with a spring so that it recedes while the cutting is being done, and when the hole is made, the spring ejects the core from between the cutters. A stop pin, placed as indicated limits the movement of the center. —FRANK KOTULSKI.

Bit of Thread Indicates Leak in Air or Gas Lines

MANY times we should like to know with certainty whether a seat, gasket or union is leaking. Perhaps we have no soap suds or light available for a test, or it may not be safe to have a light about.

In that case a bit of thread, held in a split in the end of a match or toothpick, may be held close to the connection as shown. It will vibrate if there is any leakage, thus indicating accurately the condition of the joint.

Using thread to test for leaking gas

The writer has used this method many times, and found that it will indicate anything any other test will under the same circumstances.—FRANK W. BENTLEY, JR.

Fat Men!

This new self-massaging belt not only makes you look thinner INSTANTLY—but quickly takes off rolls of excess fat.

DIET is weakening—drugs are dangerous—strenuous reducing exercises are liable to strain your heart. The only safe method of reducing is massage. This method sets up a vigorous circulation that seems to melt away the surplus fat. The Weil Reducing Belt made of special reducing rubber, produces exactly the same results as a skilled masseur, only quicker and cheaper. Every move you make causes the Weil Belt to gently massage your abdomen. Results are rapid because this belt *works for you every second.*

Fat Replaced by Normal Tissue

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A Gift Boudoir Cabinet

(Continued from page 86)

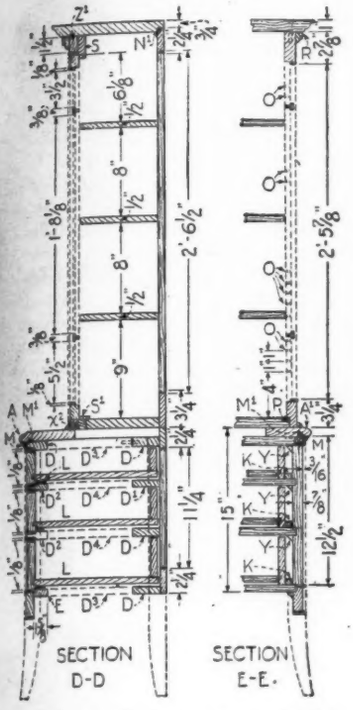

Fig. 3. An end section and a partial front section. Compare with Fig. 2

Thirty linear feet of beads ⅛ by ½ in. are required for the upper case and 36 ft. ⅛ by 1 in.

One piece for drawer front, ⅞ by 3 by 20¼ in.; two for drawer sides (con.), ½ by 3 by 12¼ in.; one for drawer back (con.), ½ by 2¼ by 20¼ in.; one for drawer front, ⅞ by 3¾ by 20¼ in.; two for drawer sides (con.), ½ by 3¾ by 12¼ in.; one for drawer back (con.), ½ by 3 by 20¼ in.; one for drawer front, ⅞ by 4½ by 20¼ in.; two for drawer sides (con.), ½ by 4½ by 12¼ in.; one for drawer back (con.), ½ by 3¾ by 20¼ in.; and three for bottoms (con.), ½ by 12¼ by 19⅛ in., rabbeted to fit grooves in drawer sides and front. Verify all dimensions.

Six pieces for drawer runs K, Fig. 3, ½ by ⅝ by 10 in. Six drawer stops L, 3/16 by 1 by 2 in. One piece filler M^1, 3/16 by ¼ by 21¼ in.; glue to face of partition D. One piece cove molding M, ¼ by ¼ by 60 in.

The upper case is made as an independent unit. The ends may be made solid, if the worker desires, to avoid the work necessary to make the glass end. The parts needed are as follows:

One piece for top, 1 by 10½ by 25½ in., molded on front and two ends and rabbeted ¼ by (Continued on page 136)

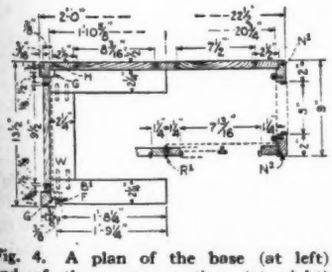

Fig. 4. A plan of the base (at left) and of the upper section (at right)

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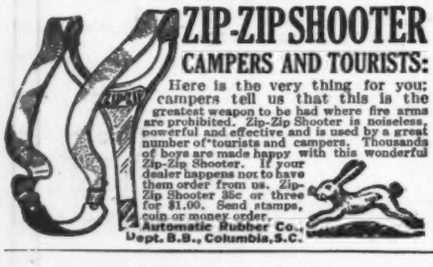

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A Gift Boudoir Cabinet

(*Continued from page 135*)

½ in. at N¹, Fig. 3, to receive the back. Four pieces for stiles, ⅞ by 2 by 35 in.; add 1 in. to allow for squaring. Two pieces for bottom rails, ⅞ by 2¼ by 5 in., and two for top rails, ⅞ by 2⅞ by 5 in. Fit together with dowel joints and glue. Square ends to exact length. Smooth both sides, cut rabbet for back as at N¹ and make rabbets ⅛ by 1 in. for beads as at N², Fig. 4. Drill holes 1 in. apart as at O to receive the screw eyes that support the shelves. Make rabbet ¼ by ⅞ in. at P to receive case bottom; stop the rabbet, and fit the shelf at the front with shoulders by the same method used in partitions of drawer case, as at B¹, Fig. 4. Fit and glue ½ by ⅛ in. beads in the glass openings.

Twenty linear feet ⅜ by ⅝ in. rabbeted glass rails and muntins as shown in detail T, Fig. 5.

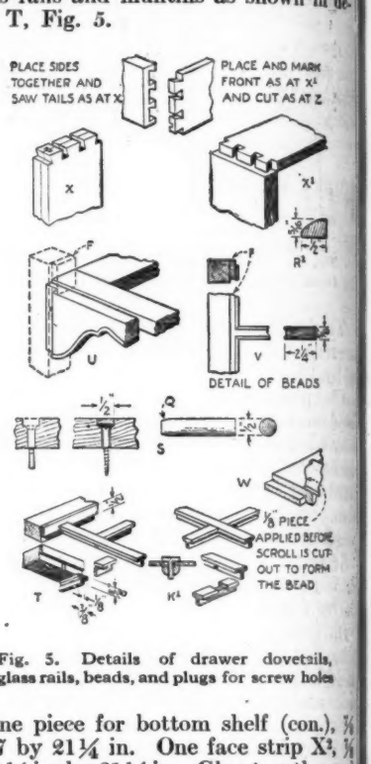

Fig. 5. Details of drawer dovetails, glass rails, beads, and plugs for screw holes

One piece for bottom shelf (con.), ⅞ by 7 by 21¼ in. One face strip X², ⅞ by 1½ in. by 21¼ in. Glue together and fit into rabbet P. Rabbet front edge ¼ in. by 1 in. for bead.

Two pieces for back stiles (con.), ⅞ by 2½ by 35¼ in.; add 1 in. to allow for squaring. One bottom rail (con.), ⅞ by 3¼ by 17 in.; one top rail (con.), ⅞ by 2¼ by 17 in.; two panels (con.), ½ by ⅞ by 30½ in., made 1/16 in. narrower to allow for swelling. One muntin (con.), ⅛ by 2½ by 30½ in. Tongue and groove these pieces as shown and glue the back together.

One header, Z¹, Fig. 3, ⅞ by 1½ by 21 in. Fit it in the rabbets for the beads at the top of the ends, and fasten with dowels and glue.

Fit the case top and fasten with dowels and plugged screws as at S, Fig. 5.

One dentil strip R, Fig. 3, ½ by 1 by 50 in. Make ¼ by 5/16 in., quarter round on one edge, miter corners and cut the dentils, so that a full dentil will come at the corner and the back; glue and brad in place. Miter (*Continued on page 137*)

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A Gift Boudoir Cabinet

(Continued from page 136)

and glue ⅛ by 1 in. beads around the door opening.

Select straight stock for the doors: four door stiles, ⅞ by 1¼ by 32⅝ in.; add 1 in. for fitting; two top rails, ⅞ by 1⅝ by 7⅛ in.; two bottom rails, ⅞ by 1⅝ by 7⅛ in. Allow ⅛ in. in width for fitting the door. Verify dimensions.

Three shelves, ½ by 7⅜ by 20¾ in. Forty-eight linear inches ⅝ by ½, not a quarter round but shaped like quarter of an ellipse as at detail R², Fig. 5.

Fit locks in drawers with brass rim escutcheons and bore holes for either bail or knob drawer pulls. Be sure the entire cabinet is thoroughly sandpapered.

Remove the drawer pulls, take doors off, leaving the hinges on the doors, and finish cabinet, either in the natural wood or by staining it. Fill the grain if open grain wood is used. Give three or more light coats of shellac, rubbing down with No. 6-0 sandpaper after each coat and finishing the last coat with wax. Do not shellac or wax the rabbets that are to receive the glass.

FIFTY linear feet of glass strips, ⅛ by ⅝ in., detail K¹, Fig. 5. Stain the glass strips and give them one coat of shellac, on face only. Fit each glass space with strips, mitering the corners. Leave them in the space or number them. Cut and clean the glass, remove the strips, put the glass in the rabbet, touch the back of the strip lightly with glue, put it in place and hold it with weights, small clamps, or with the fingers, as there is not enough wood to allow even the smallest brads to be driven. The glass may be set with colored putty if preferred; in this case use very small pins or glazier's points to hold the glass.

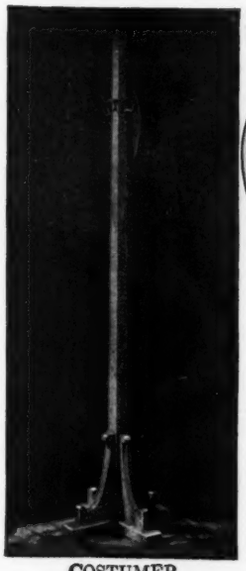
After the glass has been set give all the strips (or putty) a light coat of shellac and rub it down with No. 00 steel wool.

Hang the doors, put on the drawer pulls, wax the drawer sides and runs with paraffin wax to make the drawers run easily, and the cabinet will be finished.

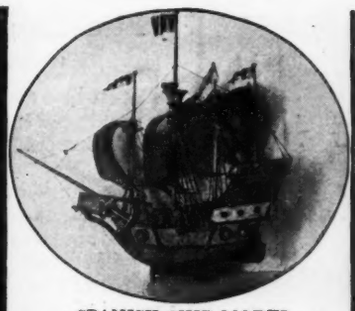
How to Guard against Brown Spots When Painting Cedar

DIFFICULTY is sometimes experienced in painting red cedar siding because disfiguring brown spots come through the paint. Some painters test cedar siding beforehand by applying a strong solution of household ammonia to a few of the boards. If discoloration appears in the course of a few hours, the best practice is to let the siding weather for a month or two before painting, or to apply a priming coat made with red lead instead of white lead. The spots are caused by water-soluble brown matter, especially when moisture is present because of newly plastered walls, and the red lead seals in this coloring better than white lead.—S.T.

THE next time you have an umbrella that is beyond repair, put it aside for the "spare parts" it contains. A whole rib from it may be substituted easily for a broken rib in any similar umbrella.



COSTUMER
See LePage's Book, page 10



SPANISH SHIP MODEL
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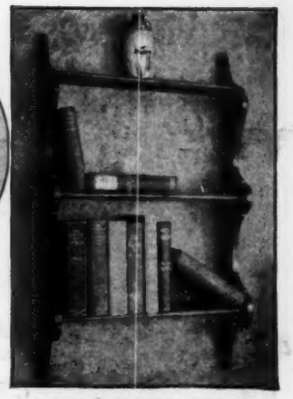

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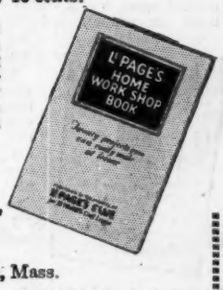

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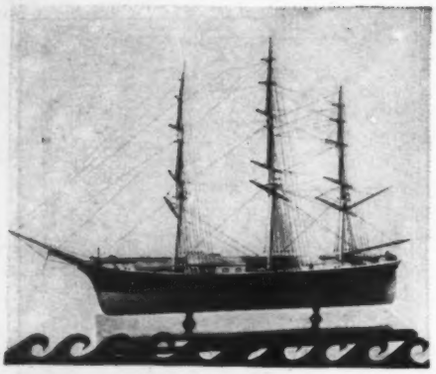

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Finishing a Ship Model

(*Continued from page 84*)

an open box and pour on a quantity of dry sand until the cloth has been stretched and permanently set.

After smoothing out the wrinkles and ironing the warped cloth over a bag of sand, hang it by the corners and spray with a thin solution of clear lacquer. The sail will then hold its shape.

Most of the old-time ships had a large amount of flat gold decoration. To bronze some of the tiny designs and emblems with a brush is a task that takes plenty of patience. A simpler method is to gold-bronze half a dozen sheets of a good bond paper on one side and cut out the figures with manicure scissors and penknife, gluing them where we wish.

PLANKING the hull of the ship adds greatly to the effect, but the labor involved is great and a single slip of the scoring tool may spoil hours of labor. However, we can score the deck planks. With a steel straightedge and a carving tool or even a sharpened nail, we'll cut our planks to represent a width of a good six inches. Then we'll fill in the minute grooves by swabbing the deck with a rag wet with a dark paint. When this finish is dry, sanding the whole deck in a light, irregular manner will bring out the planks distinctly.

The sides of the hull under the anchor and below the scuppers and waste pipes were generally of a rusty color, as the waves and rain caused the ironwork to rust and carried the marks down the sides. With an air brush or spray, a yellow-red pigment, and a fair amount of patience, we can simulate the effect to a nicety.

Our model boasts of a great number of small windows. Pieces of thin celluloid, cut to the proper size and ruled on one side with a light colored pigment to imitate the mullions and on the back painted black to give depth, can be glued to the hull to solve this problem.

Flags and pennants are a nuisance to make because of their small size, but they add so much to the ship's beauty that they are well worth the trouble. With the textile paints that are now so popular, we can paint on one large piece of a sheer silk all the pennants, flags, and canopies we need. Each piece can then be cut out oversize, warped to the proper shape, and sprayed with clear lacquer such as we used on the sails. As soon as they are stiff enough to handle, they can be trimmed with a pair of manicure scissors. No trouble will be experienced with the edges' fraying.

Keeping these little points of refinement in mind will result in a much more beautiful and valuable model.

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Better Heating

(Continued from page 77)

the evening and at night. Women will find it very little trouble to put two or three shovels of coal on the fire once, twice or possibly three times a day, with the certainty that it will burn with no more attention than turning a switch. With thermostat control one may arise and dress in a warm house with no thought of the fire until after breakfast. Throughout the day the temperature of the house will remain at 70 degrees if sufficient coal is added. If no

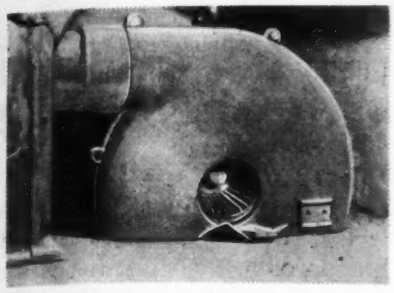


Fig. 3. This outfit cost $15 for the motor, $5 for the turbine wheel, $1.50 for the cover, and $3 for switch, wiring, and hardware. An alarm clock starts the blower in the morning

automatic controls are used, the attention necessary is the same as for natural draft, except that a switch is operated instead of draft chains.

Figure 1 illustrates the cheapest form of a blower—a discarded vacuum cleaner, stripped of bag, wheels, handle, and nozzle, supported from a standard pipe ell of proper diameter, which is passed through the pit wall and secured with a lock nut on each side. A current-carrying rheostat or a lamp of the proper resistance must be inserted in series with one wire leading to the motor to regulate its speed, as an excess air at high velocity is wasteful and does not give perfect combustion. This type of blower will work more satisfactorily if the intake and exhaust openings are enlarged as shown in Fig. 2. Such a motor, being universal, may interfere with radio reception, and current consumption is higher than necessary because of the resistance loss.

Figure 3 is a blower constructed at home from a standard $^1/_{12}$-h.p. induction motor. It does not interfere with radio reception and is almost silent in operation. The turbine wheel may be purchased from any manufacturer of this type of blower and will be perfectly balanced. The hole may be either reamed to fit the motor shaft or bushed down. Make sure of a good fit to preserve the balance.

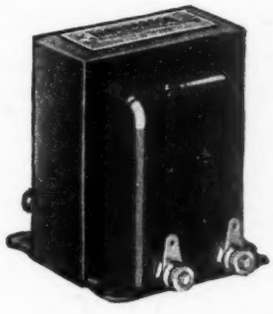
The cast-iron cover was salvaged from a discarded forge blower, but a heavy gage galvanized cover made 2 in. greater in diameter and as close a fit as possible in thickness would be more efficient. Design it approximately as shown in Fig. 4, and fasten it to the same wooden base to which the motor is attached, or, if it is well braced to prevent vibration, it may be mounted directly on the motor frame. Make a short section of pipe of heavy gage galvanized iron the same shape as the discharge

(Continued on page 140)

TO POSSESS a radio set equipped with Thordarson Amplification not only indicates taste and discrimination, but points to the owner's appreciation of the intangible beauties of perfect reproduction of fine music.

More and more, leading receiver manufacturers have been brought to the realization of the musical supremacy of Thordarson Amplification until Thordarson Transformers now are found in the majority of quality radio sets.

Whether buying or building your receiver — if you enjoy good music—insist on Thordarson Amplification.



THORDARSON
AUDIO
AMPLIFICATION

Supreme in MUSICAL PERFORMANCE!

3558

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

All Who Love to make things

Model Makers ~ Amateur Mechanics Experimenters, etc. Study the specifications of this ultra-quality line of dependable machine tools, selling at prices you can afford.

Knapp Lathe No. 930
Turns wood up to 5 in. length, 2⅝ in. diameter. Tool rest, head rest, tail stock all fully adjustable. Complete with 3 step pulley, 3 high grade cutting tools, and instruction book.
$6.00, Denver West $6.50
Shipping Wt. 4 lbs.

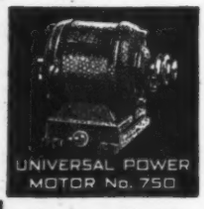
Samples of work done on the Knapp Lathe with Outfit 935, consisting of 12 interesting and useful turning designs, and templates, 43 white pine blocks, 5 in. long, from ⅛ to 1⅛ in. diameter.
Outfit 935, $1.25
Shipping Wt. 7 lbs.

Knapp Jig Saw No. 900
Capacity up to 3/8 in. lumber, also bakelite, celeron, etc. Handy for making radio panels, as well as jig saw and scroll work. Instruction book, wood with design laid out ready for cutting and 3 blades furnished.
$4.00, Denver West $4.25
Shipping Wt. 3½ lbs.

Sample of work done on Saw No. 900 from Outfit 902 which consists of 20 boards, 4½ x 12 x 3/16 in. and 12 designs for making everything from toys to practical household articles.
Outfit 902, $2.00
Shipping Wt. 6 lbs.

Knapp Speed Drill No. 910
Takes 1/16 in. to 3/16 in. dia. drills. Drills wood, iron copper, brass, aluminum, lead, slate, bakelite. No workshop, whether you work wood or metals, complete without one. Instruction book.
$4.50, Denver West $4.75
Shipping Wt. 4 lbs.

Knapp Universal Motor No. 750
1/35th horse power, a.c., d.c. 105-130 volts, any commercial frequency. Equipped with switch, 2 step pulley, 6 ft. cord separable plug. Hard drawn copper commutator, mica and bakelite segment insulation, bronze bearings.
$7.50, Denver West $8.00
Shipping Wt. 3½ lbs.



Transmission No. 975
7 Pulleys all adjustable on shafting by setscrews. Shafting adjustable on uprights. 8½ in. high, 12 in. long, A big value . . . One of a line of 5 transmissions, priced from $1.00 to $7.50. This one
$3.50, Denver West $3.75
Shipping Wt. 3 lbs.

Send 10¢ for full color catalogue fully describing Knapp American Industry in Miniature—a real line of miniature machine tools that work.

Go to your dealer and see a Knapp Work Shop with all these tools mounted and assembled $27.50 —at any hardware, sporting goods or department store (toy dep't usually).

If out of stock we will send direct on receipt of price plus forwarding costs.

KNAPP ELECTRIC CORPORATION
Dept. 88 PORT CHESTER, N.Y.
Also manufacturers of Knapp Electric Questioner

In Canada: THE T. EATON CO.
(Canadian prices slightly higher)

Better Heating

(Continued from page 139)

pipe. A flange should be formed at one end to allow it to be bolted to the wall of the ash pit. Fasten the motor base to the floor in the most convenient location for the blower, in the rear of the furnace if possible. Allow a 1-in. clearance between the two pipes, after having cut an opening in the ash pit central with the blower discharge and bolted the pipe in place. The opening may be easily cut by drilling a series of holes close together around the perimeter. Connect the two pipes by means of a short section of inner tube.

The greater the area of the intake and discharge openings, the better the natural draft effect between blower operations, and the lower the velocity of the forced air. Enlarging the openings on the vacuum cleaner, as shown in Fig. 2, accomplishes this result. A quart tomato can served as a discharge pipe; a square coffee can would do well also. Remove the end, leaving the double tin edge for reinforcement.

Sufficient volume of air at low pressure (.2 to .4 hydrostatic) closely approaches natural draft action and boiler efficiency.

Blowers designed and sold for this purpose may be purchased for from $40 to $85, depending on capacity. The formula will show the proper size. Thermostatic control systems may be purchased for from $37 to $90, any of which are also capable of operating the draft doors in mild weather when forced draft is unnecessary.

The cost of operation may be disregarded. If you allow the vacuum cleaner blower to operate ten hours (five perhaps is more nearly correct on the average) a day for six months, it would use 180 kilowatts. A 1/12-h.p. motor would use 108 under the same conditions. At 7 cents a kilowatt hour, there is $5 a year in favor of the standard blower, though quietness of operation, absence of radio interference, slightly better combustion, and less attention (as carbon brushes on universal motors re- *(Continued on page 141)*

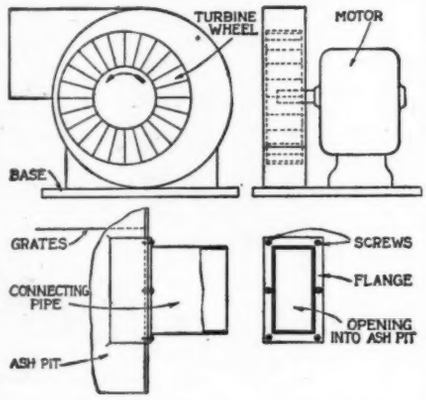


Fig. 4. How to inclose a turbine wheel in a homemade casing. In the side view above, the cover has been removed to show the location of the wheel, which is placed as closely as possible to the edge of the discharge opening. This should be the same as or greater than the intake opening in area. The intake opening is equal to the internal diameter of the wheel and, of course, centered on the wheel

Must Men Fear 40?

MEDICAL authorities agree that 65%, or nearly two-thirds, of all men past middle age, are afflicted with a disorder of the prostate gland. Here is the known cause for many of the ailments commonly ascribed to declining years—including aches in back, feet and legs, frequent nightly risings, sciatic pains, nervousness and lack of vitality. But now science knows that thousands suffer needlessly.

For a well-known American Scientist has discovered a remarkable new drugless hygiene that usually restores the prostate gland to its normal functioning. Already it has been used by more than 40,000 men—Doctors, Statesmen, Teachers, Bankers, Lawyers, men in every walk of life—with amazing results.

FREE BOOK

If you will mail the coupon below you will get, in plain wrapper, a free copy of an interesting book describing this new method. It contains facts every man should know. But send immediately, for the edition of this book is limited.

Address:

If you live West of the Rockies, mail your inquiry to
The Electro Thermal Co., Suite 40-T
303 Van Nuys Bldg., Los Angeles, Calif.

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Please send me Free, and without obligation, a copy of your booklet, "Why Many Men Are Old at 40." Mail in plain wrapper.

Name .....

Address .....

City..... State.....

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Heating

(Continued from page 140)

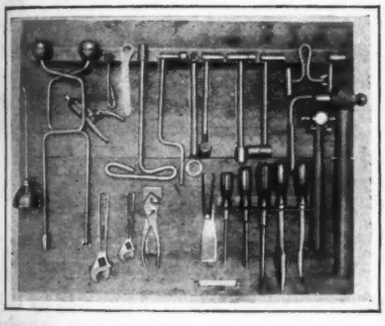
quire it, and a season's use as a blower is probably greater wear than several years as a cleaner), are the author's reasons for building the later model.

The care of the fire is comparatively simple. No fear need be felt of putting it out by smothering it. Buckwheat coal will bank a fire for 36 to 48 hours, but a few minutes forced draft will completely ignite it. To insure early ignition of the gases, it is better to leave a so-called "bright spot" at the front of the fire when putting on coal. Rake the live coals toward the front of the furnace to the door level and put the fresh coal at the back. Carry a deep fire at all times.

A CHAIN pull socket and drop cord will complete the installation, though permanent wiring should comply with Underwriters' specifications. A stout string may be used to attach the chain pull to the alarm key of a clock for early morning operation, and an additional cord or chain to the first floor will save trips to the furnace to regulate the draft.

Another article will be devoted to controls—alarm clock to start the blower one or two hours before arising, thermostats that will check the fire at the proper house temperature, and the like. For the sake of economy one can do without automatic control the first year and put the second year's saving into thermostatic control, although it is possible to have this within the first year's saving.

"Will it Pay to Buy Special Tools for My Car?"



Tools for the care of your auto deserve being kept in good order on a rack like this

ANY car owner who hesitates to undertake repair work on his auto because he has not the proper set of tools, can well afford to buy a few special tools. These will save money and afford him pleasure and satisfaction.

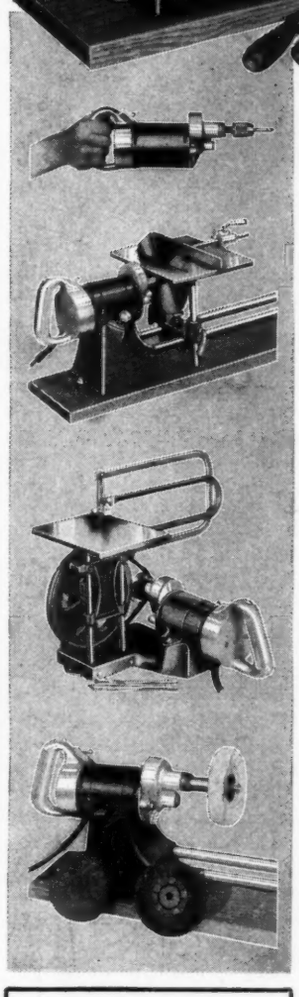
Among the general tools are adjustable wrenches, screw drivers, hammers and bearing scrapers. If a valve spring lifter is desired, it may be general or it may be designed especially for the one make of car. Wrenches are very largely special, but their cost is not prohibitive. One major job will pay the cost of a lot of them.

The tools should be looked after and not abused. A good way to keep them handy is on a rack such as that illustrated.—RAY F. KUNS.

NOW! Make Things At Home with The New RED JACKET HOME Work Shop

SENT ON TRIAL

Only $10.00 DOWN



WACO CRAFTSMAN'S WONDER WORKING LATHE

CRAFTSMANSHIP is now accomplished without labor. Red Jacket electrically driven tools turn out work like magic. Here is a complete made to order workbench equipment of perfect, efficient and powerful craftsman's tools that are small and compact enough for portable use and so inexpensive that any man or boy may have one.

Red Jacket

A chest full of tools designed by a master for the private use of tool lovers and men who want to build, construct, invent and create at home. You will be able to make everything—attractive odd furniture, toys, home and garden improvements, all around manufacturing, repairing.

Turning
Sawing
Winding
Spinning
Grinding
Buffing
Polishing
Cabinet Making
Scroll Sawing
Drilling
Repairing
Dove tailing
Pointing
Jointing
Sharpening
Sanding
Scratching
Carving
Successful Masterpieces

The Complete Equipment

consists of the powerful Red Jacket Motor, with direct drive to the Waco precision wood turning lathe (capacity 9 in. x 34 in.); a bench saw, that has depth and side gauges, scroll and jig saw; and all accessories for both portable and stationary power drilling, buffing, grinding and cleaning. Attaches to any light socket and converts your work bench into a complete private tool and machine shop.

The Waco Guarantee

If It Is Not What You Want When You Get It—Send It Back

free CRAFTS COURSE

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And blueprint service is free to Red Jacket Shop owners—all that there is to know about handicraft methods, raw materials, woods, carving, sawing, turning, designing, carpentering, decorating, is taught by special correspondence.

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Our literature tells you how to start a job of your own. If you are not pleased return the Shop.

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Manager, Dept. 10. Please send me particulars about 10-day free trial, free blueprints, and $10 down payment.

Name.....

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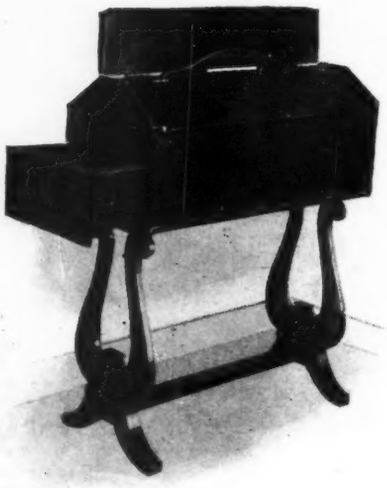
A Sewing Cabinet of Rare Charm

Designed in Duncan Phyfe Style—Simple Enough for Boys to Build

By JOHN L. HONAN



The lyre-shaped legs and fine proportions of this cabinet give it unusual distinction

IS THERE a woman who would not appreciate the gift of such a charming sewing cabinet as this?

The design follows closely upon the lines of Duncan Phyfe, most famous of early American furniture makers. Accordingly, the piece should be built of mahogany or some wood that may be finished in imitation of that noble wood—red birch, red gum or even whitewood. Anyone with a fair assortment of tools in usable condition, moderate ability in their use, and gumption enough to make the start, will find this an unusually interesting project.

Make the midframe of two pieces O, ½ by 1 1/16 by 16 in., and two pieces P, ½ by 1 1/16 by 6½ in., rabbeted as indicated, and mitered and nailed together like a picture frame.

The two rails of the bottom or lower frame T, ⅝ by 1½ by 16 in., are rabbeted and have their outside edges rounded as shown; the two end pieces U are ⅝ by 2¾ by 4 7/16 in. These may be joined by dowel joints, although both upper and lower frames may be put together merely with glue and corrugated fasteners. The bottom of the case may be made as a single board or paneled.

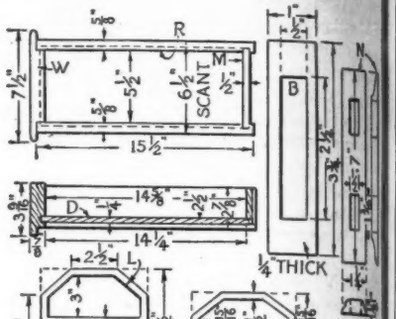
The rear end piece H, ⅜ by 7½ by 7½ in., the drawer end top piece F, ⅜ by 3 15/16 by 7½ in., the inside rear end J, ⅜ by 2 15/16 by 6½ in., the midframe center board C, ¼ by 4¼ by 13¾ in., the temporary spacer X, ⅞ by 2 1/16 by 5¾ in., which is to be used only to insure accuracy in placing the frames, and the two inside cover supports L, ⅜ by 2 15/16 by 6½ in., should be worked to given sizes and shaped.

Make two sides E, ¼ by 5 by 16 in., after which the case may be assembled with glue and brads.

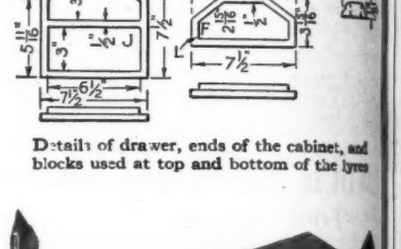
The top center piece K, ⅜ by 2⅛ by 16 in., and the handle G, ⅜ by 1½ by 10½ in., may next be made and shaped.

The four halves of the two lyre pieces Q, each half being ½ by 3⅜ by 10¾ in., should be planed along the joining edges at the bottom before being shaped, after which they may be glued together. The joint forms the center line. Be sure the bottom tenon is ½ in. long and the top tenon 1 in. long. Make the feet V, ⅛ by 2¾ in. and the stretcher S, ⅝ by 1¾ by 14⅝ in., fitting them together with a mortise joint.

Glue pieces B, ¼ by 1 by 3¾ in., upon the feet and cut a mortise through each and into each foot to receive the bottom tenons of the lyres. Make two lyre tops N, ½ by 1¼ by 7 in., shape the ends and edges, and glue strongly to the underside of the bottom frame of the case. Cut mortises to receive the 1-in. tenons of the top of each lyre. Glue lyre and case strongly together and fit 3/16-in. dowels through the feet V, the tenons of stretcher S, and into the bottom of the lyre. After



Details of drawer, ends of the cabinet, and blocks used at top and bottom of the lyres



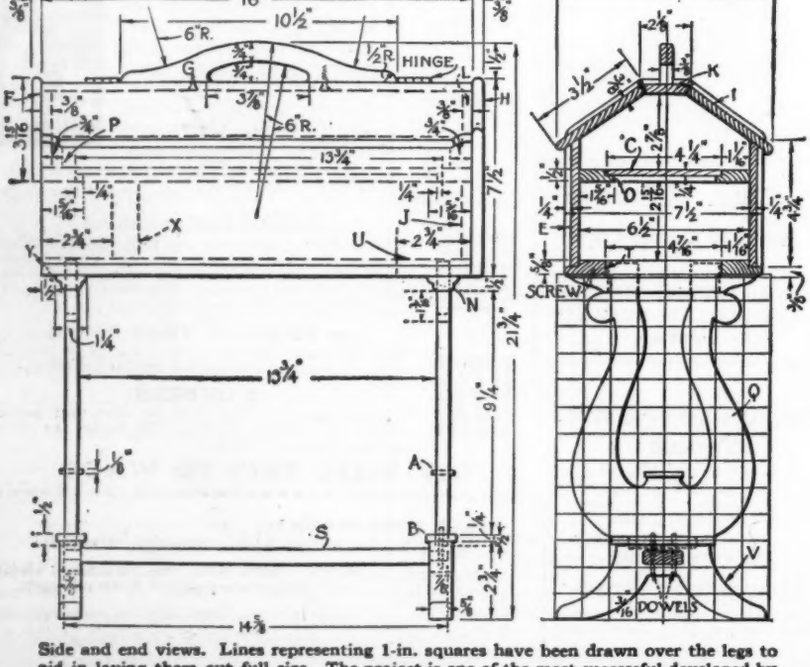
The upper part of the cabinet in the course of construction. Note the temporary spacer X

the two cover pieces I, ⅜ by 3½ by 15⅝ in., are shaped and the edges rounded, they are hung with 1-in. narrow brass butts (hinges). The lyre cover pad A, ⅛ by ⅝ by 1 3/16 in., may be made next and glued and bradded in place.

In making the drawer (parts W, R, M and D), it must be remembered that the more closely a drawer fits without sticking the more easily it will run. Cut a corner out of U at Y to allow the finger to catch under the bottom edge.

If made of mahogany, the piece should be stained, filled, and finished with shellac and wax, varnish, or thin shellac followed by clear lacquer.

If made of a less expensive wood, it may be finished in the same way or painted with enamel or colored lacquer, and ornamented with delicate decalcomania (transfer) designs. The painted finish can be given an antique effect by applying and then rubbing partly off a thin mixture of raw sienna, burnt umber and turpentine



Side and end views. Lines representing 1-in. squares have been drawn over the legs to aid in laying them out full size. The project is one of the most successful developed by Mr. Honan in his manual training classes at the Madison Junior High School, Newark, N. J

Paper Hanging

(Continued from page 80)

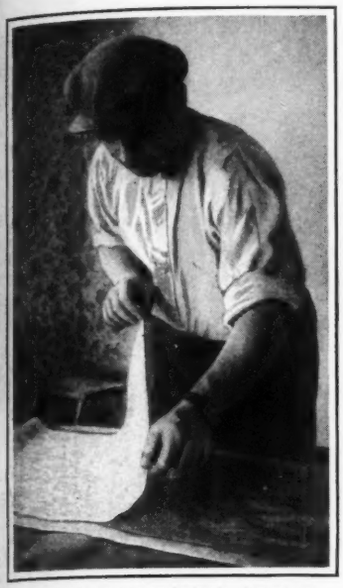


Fig. 6. When one half the length of the paper is pasted, that half is folded on itself; then the other half is pasted and folded to the center

plasters now on the market. If plaster is used, pile a little on a small board, make a hole in the center and pour in a small quantity of water. As the water soaks into the plaster remove the wet mass on a putty knife and press it into the crack or hole. Work the dry plaster to the center of the board and remove the wet plaster as needed. Fill each crack or hole completely and smooth flush with the wall. If the patch dries and shrinks so that small cracks are left around the edges, these should be later filled up in the same manner.

When the ceiling and walls are completely cleaned, they must be sized, that is, brushed with any preparation to give them a tacky surface and prevent the paste from striking in. The most convenient size is that bought ready for mixing with water, but ordinary glue size can be made without difficulty. Soak a pound of painter's dry glue twelve hours in enough cold water to cover it. Then add ten quarts of hot water and a tablespoon of powdered alum.

Hang the ceiling paper first. The few tools that are essential are shown in Fig. 2. The first strip is hung to a line parallel to the side wall (Continued on page 144)

Fig. 7. How one margin of the pasted and folded paper is trimmed with the shears

Old Briar

TOBACCO

"THE BEST PIPE SMOKE EVER MADE!"

*"My happiest discovery in fifteen years Old Briar Tobacco!"**

Here are words of sincere appreciation that reach right out to every pipe smoker. Every day, from everywhere, men are writing that Old Briar Tobacco is bringing back to them all of the old pleasure, solace and contentment of pipe smoking.

It is the superior quality of Old Briar Tobacco that makes men—thousands of them—enjoy their pipe smoking as they have never enjoyed it before.

Light up your pipe filled with Old Briar Tobacco. Draw in the ripe, blended fragrance and aroma of its selected leaf. Taste Old Briar's full natural flavor, its rich body. Smoke it awhile. Then notice how cool it is—and how smooth!

It has taken years of scientific knowledge in the art of mellowing and blending and generations of tobacco culture to produce Old Briar Tobacco. Step by step Old Briar has been developed—step by step perfected!

Of all the pleasures man enjoys, pipe smoking costs about the least.

*The above unsolicited praise is from a pipe smoker who has tried *"them all"*

TO DEALERS: *Old Briar is sold in sealed Pocket packages at 25c and sealed boxes at 50c, $1.00 and $2.00. If your jobber has not supplied you, write us and we will send you a supply by prepaid Parcel Post at regular Dealer's prices. Every box and package of Old Briar has our unlimited guarantee.*

IF YOUR DEALER DOES NOT HAVE OLD BRIAR

Tear out this coupon and mail to:
United States Tobacco Co., Richmond, Va., U. S. A.

SPECIAL OFFER: So many thousands of pipe smokers have found so much extra enjoyment in a pipeful of Old Briar, it is a guarantee to you that you, too, will find it is the best tobacco you ever smoked. On receipt of this coupon with your name and address, we will mail you the regular 50c size of Old Briar Tobacco. In addition we will send you a 25c package of Old Briar—extra—if you send us your dealer's name. Send no money, but pay the postman only 50c when he delivers the tobacco.

Print Name .....
Address .....
City and State .....
Your Dealer's Name .....
Address .....

If you prefer—send stamps, money order or check with coupon. Tear out now, while it's handy. P.S. 10-27

UNITED STATES TOBACCO COMPANY, RICHMOND, VIRGINIA, U. S. A.

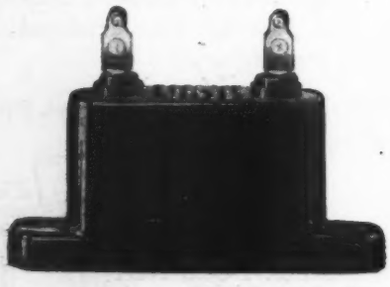
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Light Socket Aerial

There's your Aerial

and that's all there is to it!

Just connect it to the set and plug in! No "junk" out on your roof—no lead-in wires, switches or lightning arrester needed. A *Dubilier Light-Socket Aerial* and enough cord to reach the nearest A.C. or D.C. outlet brings in your favorite programs clean and clear throughout the year. Less static, less interference and no trouble at all when you use this remarkable little device. Uses no current—sold on a 5-day money-back basis. Price $1.50.



A Still Better Micadon

A fixed condenser is such an inexpensive part of a receiver that you should insist on the best obtainable. Look over the new Micadon with its moulded Bakelite case, modern shape and its two-way terminals. Accurate to a degree and exceptionally durable. All standard resistances. Prices 45c to $1.50.

Dubilier Condenser Corporation
4377 Bronx Blvd. New York

Dubilier Condensers

Paper Hanging Made Easy

(*Continued from page 143*)

and 16 in. from it. This can either be snapped with a chalk line or drawn by means of a straightedge. The first method is the better. Rub colored chalk over the line and stretch it between two nails driven into the ceiling. After pulling it down a few inches in the center, let it go suddenly so that it will snap against the ceiling and leave a chalk mark.

Examine the rolls in a strong light to see if the paper in all is of exactly the same shade. If there is any variation, grade the rolls from light to dark and use them in that order. Then the ceilings or walls will appear uniform when finished.

Measure the length of the ceiling and cut the strips about 6 in. longer, matching the pattern, if any.

Lay the strips face down on the workbench and lap over equally at each end. Draw the top strip towards you and, beginning at the left, apply paste to half the length of the strip. Paste the edges by placing the hand under the paper so that the paste will not spot the strip underneath, as in Fig. 5.

Fig. 8. Starting the first ceiling strip, which is supported with a spare roll of paper

When the paste is well spread, wait a moment for it to settle and then fold this half over on itself towards the middle of the strip. Paste and fold the second half in the same manner. (Fig. 6.)

How the edge of the pasted strip is trimmed is illustrated in Fig. 7. Stand facing the lefthand edge of the paper and cut along the edge in as straight a line as possible with the shears, cutting through both thicknesses at once, that is, the folded portions. If the cutting wheel or cutting knife is used, lay a straightedge over the paper and cut with its edge as a guide. Only the one edge is trimmed. Some papers have a perforated edge so that the margin can be torn off instead of cut.

To hang the first ceiling strip, arrange a plank at a convenient height near the wall. Lay the folded strip of paper over the left arm, mount the plank, and, facing the wall, begin at the right-hand corner of the ceiling. Unfold the right-hand end and guide the outside edge along the chalk line, supporting the other folded end over the left arm.

Lap at least 2 in. of the end of the strip on the end wall and lap the inside edge of the ceiling strip on the wall in front. Guide the paper with the right hand as you move to the left, pressing it to the ceiling with the flat of the hand and smoothing with the brush. When in place, use a spare roll of paper to hold the loose portion as shown in Fig. 8. Then unfold the remaining half and move along with it, using the roll to press it to the ceiling. If wrinkles occur, pull the paper away and flatten properly.

If the room is a large one and difficulty is experienced in handling the long strips of paper, it is well to do more folding, that is, fold each strip in accordion or zigzag fashion about every 2 ft., paste side to paste side. Do not attempt to hold the pasted and folded paper unaided, but make a very light movable platform 4 ft. high, using a soap box for the base, strips of wood for the uprights and a piece of wallboard or light wood for the top. Set this platform on the plank about 4 ft. from the right end, place the pile of paper on it, and then push it along with your foot as you raise the paper from it.

Subsequent strips are applied in the same manner as the first, and each is slightly lapped over the previous strip.

Next month Mr. Robbins will tell how to paper the side walls.

How Much Wall Paper to Order

Width of Room	Length of Room	Rolls for Side Wall			Rolls for Ceiling	Border in Yards
4	10	7	8	9	2	11
6	10	8	9	10	2	12
6	12	9	10	11	3	13
8	12	10	11	13	4	15
8	14	11	12	14	4	16
10	14	12	14	15	5	18
10	16	13	15	16	6	19
12	16	14	16	17	7	20
12	18	15	17	19	8	22
14	18	16	18	20	8	23
14	22	18	20	22	10	26
15	16	15	17	19	8	23
15	18	16	18	20	9	24
15	20	17	20	22	10	25
15	23	19	21	23	11	28
16	18	17	19	21	10	25
16	20	18	20	22	10	26
16	22	19	21	23	11	28
16	24	20	22	25	12	29
16	26	21	23	26	13	31
17	22	19	22	24	12	28
17	25	21	23	26	13	31
18	22	20	22	25	12	29
18	25	21	24	27	14	31
20	26	23	26	28	17	33
20	28	24	27	30	18	34

If the room is 8 ft. high, use the first figure under the heading "Rolls for Side Wall," if 9 ft., use the second figure, and if 10 ft., the third.

OAK may be given an antique color with a prepared Jacobean oil stain or equal parts of Vandyke brown and burnt umber and a trace of drop black (these are inexpensive dry colors) mixed with raw linseed oil and thinned with turpentine. Let dry thoroughly and then "high light" with very fine sandpaper, that is, remove some of the stain on the edges of moldings, centers of panels and in places where the effects of wear might be seen if the piece of furniture were very old. A wash coat of one part of orange shellac and one part of alcohol is applied and then two coats of slightly thinned shellac and several coats of paste furniture wax.—J. L. H.

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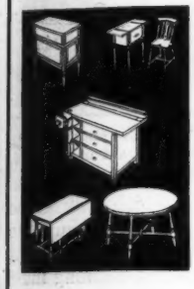
UP-TO-DATE MACHINE WORKS

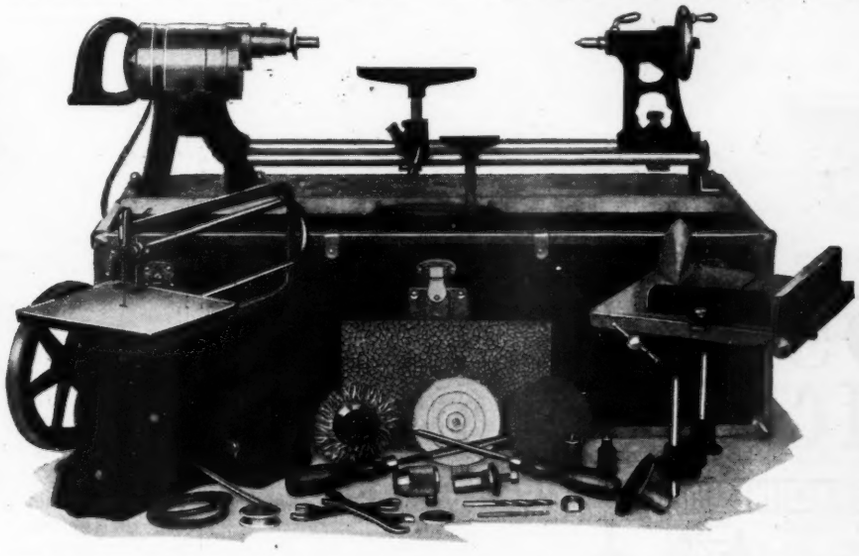
UP-TO-DATE HOME-CRAFTSMAN SHOP

This result of mechanical genius, a handy up-to-date, made to order work-bench equipment, bears your investigation. Illustrated below, we present for your inspection, a complete set of craftsman's precision tools that are indorsed by Master Mechanics as being as efficient, portable and convenient a set of home-work-shop implements, as has ever been offered for public use. The installation of a precision wood turning lathe, electric saws, and such equipment as is necessary to make your work-bench a source of real accomplishments in home mechanics has until now, necessitated a big money investment. It is now possible with only $10.00 down to get the entire equipment pictured below.

We have prepared volumes of interesting literature and information, giving a detailed explanation of each part of our Up-to-Date Home Craftsman Shop. This information may be had without any obligation on your part by mailing the corner coupon.

ONLY $10 DOWN





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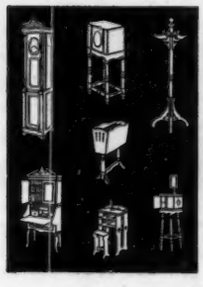


HOME MECHANICS MADE EASY WITH THE NEW UP-TO-DATE HOME-CRAFTSMAN SHOP

The Up-to-Date electrical Home Craftsman Shop can be used in any home lighting fixture thus making of your old fashioned work bench a complete machine shop. The shop complete is made up of a Super-power motor, a genuine precision lathe (10x34 inches) which features the bevel, a miter, side and depth gauges, a superior scroll and jig-saw, and all accessories for buffing, grinding, cleaning and all portable or stationary drilling and sawing. This collection of electrically driven tools which is complete in every detail, will make you an advanced craftsman.

Master mechanics have designed and skilled engineers have constructed this equipment which after inspection, you will agree is the best of its kind. For those who build, invent, create and construct at home, it is unexcelled.

OUR EDUCATIONAL DEPARTMENT

Under Personal Supervision of Master Craftsman Eugene E. Maurey offers special correspondence crafts course giving in simple detail full information on home handicraft. Blueprint service included in this course FREE to our users.

GUARANTEE

After receipt of the Up-to-Date Homecraftsman's Shop if you are not satisfied, without question or delay every cent refunded and return express charges paid.

14" Band Saw
Accessory to Up-to-Date Shop

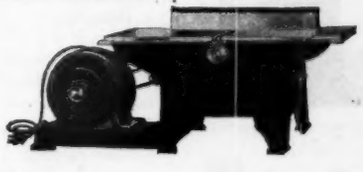
NOT A TOY, A REAL MACHINE

Carefully Designed Blue Prints Free to Shop Owners

Working blue prints of furniture and other items which are useful about the home and shop. Hundreds free to shop owners.

Drilling	Polishing
Turning	Buffing
Grinding	Scroll Sawing
Sawing	Cabinet Making
Jointing	and numerous
Pointing	other operations
Sanding	necessary to real
Carving	craftsmanship

4" Jointer Model A-1928 Accessory to Up-to-Date Shop



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Use our shop for 10 days at our expense, if not satisfied—Return—express collect.

OUR LITERATURE GIVES ALL DETAILS

Your own terms on purchase. $10.00 down—balance arranged to your convenience. Liberal discount for cash.

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UP-TO-DATE MACHINE WORKS
2915 South Wabash Ave., Chicago, Ill.

MANAGER, Dept. A;—Without any obligation please send me full particulars about your shop, 10 day free trial, free blue prints, free crafts course. Also $10.00 down payment offer.

NAME.....

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Wire coating represents years research

Delicate actuating parts of loud speakers are subject to rust and deterioration. The Crosley patented actuating unit is not affected by the climate. Special impregnable coating covers the wire in the coils. Impervious bakelite instead of cardboard bobbins prevents any retention of moisture. Higher voltage is possible with resultant louder, finer tones. Beware of imitations. Remember the cone shape is *not* the secret of Crosley Musicone performance but the patented non-imitatable actuating unit of tremendous capacity.

If you cannot locate your nearest dealer write Dept. 17 for his name and literature.

WORLD'S *fastest selling* SPEAKER

12-in. Ultra MUSICONE $9.75

16-in. Super Musicone $12.75

Prices slightly higher west of the Rocky Mountains

CROSLEY MUSICONE

The Crosley Radio Corporation
Powel Crosley, Jr., Pres.
Cincinnati, Ohio

MAKES A COMPLETE MACHINE SHOP

EVRY-USE Electric MOTOR ATTACHMENT

Fastens on shaft of small motor in a jiffy. Holds attachments for Grinding, Polishing, Sawing, Drilling, etc. MADE TO FIT ⅛-inch, ¼-inch and ⅜-inch shafts STATE SIZE

ONLY $3.95

Also Electric Motors at Greatly Reduced Prices.

Write Us YOUR Requirements.
UNITED ELECTRIC MOTOR CO.
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$1.00 VIOLIN LOUD SPEAKER
Make it yourself

Last word in radio speakers! The violin that talks! Make it yourself in an hour. Any cheap violin or cigar box will do. Tune it up same as any violin and play to beat the band. Brings in all notes with amazing clearness and sweetness, especially low notes and drums. Improves any receiver; friends marvel at it. Complete directions sent postpaid upon receipt of $1.00. Write George T. Hastings, 21 Gorham Pl., Dept. O, Scarsdale, N.Y.

Two New Quality Products

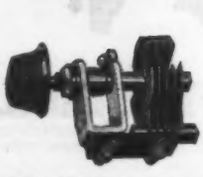
by the makers of the famous

HAMMARLUND CONDENSER

The New Hammarlund R. F. Choke

Modern engineering practice has proved the value of R. F. chokes for confining radio-frequency currents to their proper channels, thus preventing unbalanced circuits and consequent distortion.

This is a *quality* idea, ideally exemplified in the use of the new style Hammarlund Choke. Made in two sizes: 85 and 250 millihenries, effective over the entire broadcast and amateur wave-band.



The Improved "Hammarlund Jr."

The famous Hammarlund Midget Condenser has been simplified. The new "Hammarlund Jr." has all essential features of the former model—soldered brass plates, aluminum frame, one-hole or baseboard mounting. Knob included.

In addition, it is equipped with a rotor lock which fixes the rotor plates in any position—an important advantage when used for neutralizing. Four sizes.

HAMMARLUND MANUFACTURING COMPANY
424-438 W. 33rd Street
New York

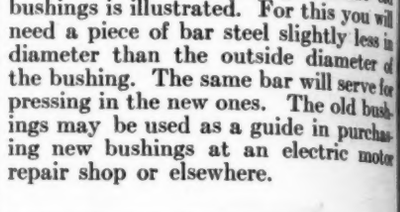
For Better Radio
Hammarlund
PRECISION
PRODUCTS

Replacing Electric Motor Bushings

By George A. Willoughby

UNBALANCED armatures or tight belts often cause excessive wear of the bushings in an electric motor. Even under normal use, the wear may be sufficient to require rebushing. This can be done quite easily in the home shop.

One method of pressing out the old bushings is illustrated. For this you will need a piece of bar steel slightly less in diameter than the outside diameter of the bushing. The same bar will serve for pressing in the new ones. The old bushings may be used as a guide in purchasing new bushings at an electric motor repair shop or elsewhere.



The old bushings may be pressed out and the new ones inserted with the aid of a vise

The new bushings, which will be too small for the shaft, must be reamed to fit. The reamer must be exactly the right size for the shaft and the reaming must be done most carefully.

After the reaming has been done so that the shaft fits rather tightly but still can be turned, it is well to wear the bearings in by running the motor by means of some outside source of power, keeping the bearings lubricated. If this cannot be managed and an attempt is made to run the motor by connecting it to an electric line, be very careful to avoid burning out the motor windings. If the motor does not start readily, ream the bushings a little more. Even after it has started to run, watch it carefully and if it starts to get hot, shut it down until it has cooled off. Then run it a little more.

Old Monkey Wrench Jaw Serves as Anvil for Delicate Work

THE anvil in most of our small home workshops is an old cast-off flatiron, but for bending and riveting very small parts, the back jaw and screw of a scrapped 12- or 14-in. monkey wrench is better. A washer is placed on each side of the bench top when the jaw is clamped in place, as shown.—F. W. B.

Small anvil made from discarded wrench jaw

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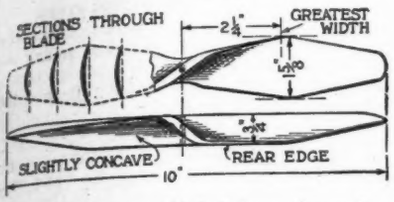
A Flying Model

(Continued from page 88)



The propeller is whittled from pine and covered with thin silk to prevent splitting

and 4, 2½ in.; 4 and 5, 3 in.; 5 and 6, 3 in.; 6 and 7, 3 in.; 7 and the sternpost, 2 in.

From station No. 3 forward, all strut ends are reinforced by binding with silk thread, as are the longerons at the points where these struts are attached. The joints of the fuselage are made with thin ½-in. brads and glue, and completed for tension strains by binding six wraps of silk thread about the perimeter of each rectangle formed by the vertical and horizontal compression struts.

The diagonals J are now cut to fit, forced into place and glued. A diagonal is placed in each side between stations Nos. 1 and 2, rising from the lower longeron at No. 2 to the upper at No. 1. Two diagonals J are set in the vertical plane between stations Nos. 2 and 3. These continue downward from Nos. 2 and 3 and converge on the lower longeron at a point midway between Nos. 2 and 3. At this point also is a horizontal follow-through strut K, which runs across the bottom. The plane formed by the follow-through strut and horizontal struts Nos. 2 and 3 is cross braced with twelve wraps of silk thread each way.

THE motor stick M is white pine, ¼ by ¼ by 16½ in. Cut a block TT, ¼ by ¼ by ⅜ in. and groove the top to form a cradle for the bearing P, which is an ordinary bicycle spoke nipple.

The nose plate L is a white pine disk ⅛ in. thick and 2 in. in diameter. A hole must be drilled in the exact center for the propeller shaft. A wire hook N is formed to hold the rear end of the rubber band motor; it is fastened in a hole near the end of the motor stick and bound with silk thread and glue.

A section of the nose plate is cut out to enable the motor stick to slide up into it far enough so that the bearing and the hole in the nose plate are on the same straight line. The motor stick projects 1½ in. ahead of the nose plate. Blocks are glued and bradded to the motor stick and nose plate on top of the stick and on each side of the nose plate, and one block is placed on the underside of the motor stick in front of the nose plate.

The motor stick is placed inside the fuselage and held by gluing the nose plate to the front of the fuselage and driving a brad into the end of each longeron, after centering the nose plate. The rear end of the motor stick is supported by a cross strut Q between vertical fuselage struts No. 5 and is tied to the cross brace with a few wraps of ⅛-in. flat rubber. This arrangement allows the motor stick to twist slightly.

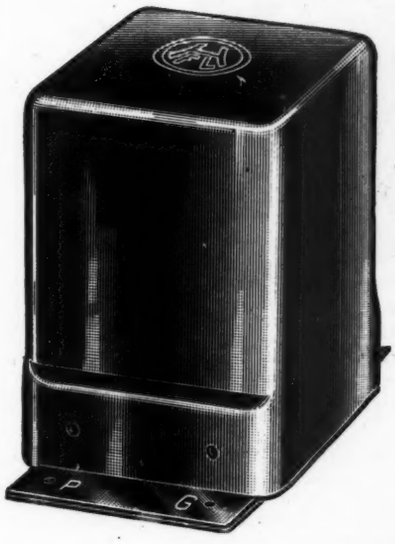
The tail skid QQ is $\frac{1}{16}$ by ⅛ in. bamboo, 3 in. long over all. The top of the skid is bound to the top horizontal fuselage strut at station point No. 7; the skid is also bound to the lower horizontal strut No. 7.

The top of the fuselage is now to be covered with china silk. The covering runs from the struts at station No. 1 to the sternpost. Cut the silk with a ¼-in. margin and stick it to the top longerons with dope. This must be done quickly. After the dope dries, trim off the margin with a safety razor blade or sharp knife; then give the surface three coats of dope.

Mount the main wing by driving a brad through the spars just inside the center ribs and into each end of the horizontal struts at stations Nos. 2 and 3. (Continued on page 148)

Transformers

Two additions to last year's Radio Sensation
The Amazing Achievement in Audio Amplifications



Designed to fulfill the exacting requirements of set builders who demand

EFFICIENCY
SENSITIVITY
PRECISION AND
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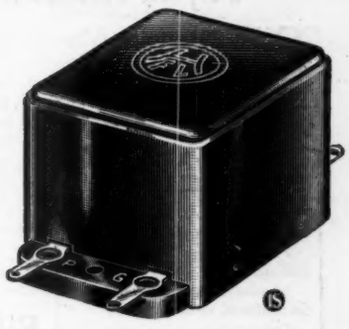
The new C-16 and C-25 Transformers will work in any circuit and will improve any Radio Set.



H. F. L. C-16 Audio Transformers and C-25 output Transformer—New companions of a Great Unit, will work in any circuit and improve any radio set.

H. F. L. Units Give Wonderful Clear Reception

Engineers acclaim H. F. L. C-16 a marvellously efficient Audio Transformer. It carries signals at highest volume and lowest amplitude without blasting or developing harmonies. Operates with all power tubes as well as standard tubes.

H. F. L. C-25 Output Transformer handles the voltage output of power amplifying tubes, at the same time matches the impedance of the average speaker to tubes. Protects loud speaker unit without reducing plate voltage.

Mechanical features of these two transformers are: A coil designed and treated to exclude moisture and withstand heavy electrical surges without breaking down—complete magnetic shielding to avoid interstage coupling—terminals brought out so as to insure short leads.

Endorsed by America's Leading Engineers—Guaranteed by the Manufacturers

H. F. L. Facts

H. F. L. Units have been used, approved and most highly endorsed by *Radio News, Citizens' Call Book, Radio Review, Radio Age, Radio Engineering, Radio Mechanics, Chicago Evening Post*, the *Daily News* and others. Thousands of engineers and fans, who have turned to H. F. L. Units for better reception, hail them as the finest transformers known to Radio—unexcelled for Power, Selectivity and Purity of Tone.

Perfectly matched, skillfully designed, carefully made, rigidly tested—in a word, H. F. L. transformers are technically correct to the minutest detail.

All H. F. L. transformers are designed for baseboard mounting or invisible subpanel wiring—each unit is enclosed and sealed in a genuine bakelite moulding.

H. F. L. Units are easily connected into the assembly, simplify set construction, and make a beautifully finished job.

PRICES

No. H-210 Transformer	$8.00
No. H-215 Transformer	8.00
No. C-16 Transformer	8.00
No. L-425 R. F. Choke	5.50
No. L-430 R. F. Transformer	5.50
No. C-25 Output Transformer	8.00

Set Builders—Dealers

If your jobber cannot supply you with H. F. L. Transformers, wire us for name of nearest jobber.

HIGH FREQUENCY LABORATORIES

131-M NORTH WELLS STREET, CHICAGO, ILL.

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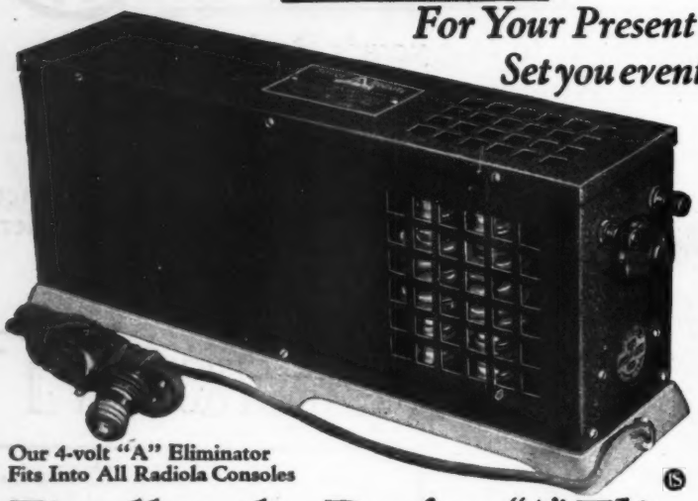
Silver A Beauty POWER

For Your Present Set or the Set you eventually buy



Our 4-volt "A" Eliminator Fits Into All Radiola Consoles

$39.50 6-volt—2 amp.

$43.50 6-volt—3 amp.

$39.50 4-volt—½ amp.

$2 Higher West of Rockies

Finally—the *Perfect* "A" Eliminator

Perfect, because its principle is simple and correct!

THE 110 volts Alternating Current is scientifically reduced with the famous *"Silver Beauty"* transformer coil to deliver the proper voltage to an *especially developed dry, noiseless rectifier*, which transforms the electricity to direct current. This current of exact voltage, is then transmitted through a patented special filter which clarifies the current, eliminating all foreign noises caused by rectifier or generator.

The result! A smooth, noiseless, constant "A" current supply, that makes radio reception the pleasure it is intended to be. *Silver Beauty* is the outstanding "A" eliminator today. It is unexcelled. Endorsed by prominent radio engineers—adopted by leading distributors and dealers—approved by thousands of users These are sufficient reasons for making *Silver Beauty* your final choice.

Silver A Beauty POWER

Replaces "A" storage battery and charger.

Has full wave "dry" rectification.

Maintains required voltage in uniform, constant flow.

Operates automatically by moving a switch.

Economical—uses minimum amount of current [about 1-10 cost of using electric iron].

Has rheostat control for additional refinement in voltage and reception.

Gives maximum power to radio tubes and lengthens their life.

No acids to test or spill.

Satisfactory Results Guaranteed

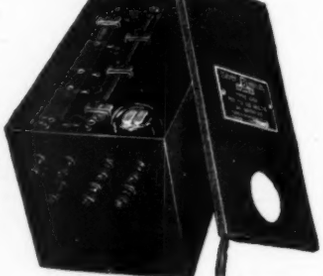
Silver Beauty "B-C" UNIT

Does away with "B" and "C" batteries

Embodies every up-to-date refinement and principle, insuring smooth, unfailing reception. As beautiful as it is efficient.

Silver Beauty CHARGERS

Employing an entirely new method of rectification. Two models—with or without bulbs.



180 Volts—40 Milliamperes $45.00

Individual adjustment adapted to all sets

Triple-A-Specialty Company

Manufacturers of the famous Silver Beauty Chargers

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New and Complete Line

Molded Mica Condensers
By-Pass, Filter and Buffer Condensers

Not affected by climatic or temperature changes. Guaranteed to be and continuously to remain within 10% of rated capacity.

Illustrated folder on request.

Any dealer can supply.

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INDISPENSIBLE

for 100% Tube Efficiency

Only Amperite supplies automatically the self-adjusting filament current your tubes require. Eliminates hand rheostats. Simplifies wiring. Insist on Amperite. Accept nothing else. Price $1.10 complete. Sold everywhere. Write for Free Hook-Ups and construction data to Dept. P. S. 7

RADIALL COMPANY
50 Franklin Street
New York City

AMPERITE

REG U.S. PAT. OFF.

The "SELF-ADJUSTING" Rheostat

A Flying Model

(*Continued from page 147*)

Complete the fastening by passing a brass wire about the spar at each end, then around the longerons, puncturing the covering where necessary. Twist the wire to hold. Be sure the wing mounting is true.

THE wing struts AA are of streamline section, made from 3/16 by ½ in. white pine. They are tapered from a point ¾ in. from each end to the end to simplify the assembling.

The sides of the fuselage should now be covered and doped. The wing struts are installed by using a brad pointed at both ends. Force the brad halfway into the wing spar and force the end of the strut on the other end. A hole is drilled through the flat side of the strut and a brass wire passed through the hole and across the spar, then twisted to hold. Puncture the covering where necessary.

The bottom ends are secured in the same manner by forcing the struts on the end of a double pointed brad; and the other end of the brad is forced through the longeron into the horizontal strut of the fuselage. Complete the joint by passing a brass wire through the strut and around the longeron.

Determine the lengths of the undercarriage follow-through struts BB. They should meet the front wing struts at a point 3½ in. from the center line of the model. These struts are streamlined from ⅛ by ¼ in. white pine.

NEXT find the lengths of the undercarriage vee-struts R and compression struts S. The vee-struts are tapered in the characteristic manner, but the compression struts are not tapered. These units are assembled with double pointed brads and wire as in the other struts. The compression struts are vertical and 7 in. apart. The compression struts and rear vee-struts are streamlined from ⅜ by ½ in. white pine. The front vee-struts are streamlined from ⅛ by ¼ in. white pine. Great care must be exercised to align these struts.

The wheels T are white pine disks ⅛ in. thick and 2 in. in diameter. The axles, which are made from bicycle-spoke wire, pass through the holes in the compression struts ¼ in. from the bottom, then up along the rear vee-struts ¾ in., and turn into a hole in the vee-strut. These are bound to the vee-struts with thread and glue. The wheels are held on the axles with a small copper washer and a drop of solder.

The propeller PP is of the "toothpick" type, made from a tapered blank. It is 10 in. in diameter and ¾ in. thick at the hub. The widest part of the blade is 1⅝ in. and this point occurs about 2¼ in. from the hub. The width near the tip is 1 in. The blades are covered with silk to prevent splitting. Fasten the silk with dope and trim off the margin with a razor blade, then apply dope over all.

Propellers of various types suitable for models can, of course, be bought ready-made, but a little practice soon enables one to whittle them satisfactorily, difficult as it may seem.

To mount the propeller, turn a rubber hook on the end of a piece of bicycle-spoke wire C, pass this shaft through the hole in the nose plate, then through the bearing. Put three or four copper washers on the shaft, then slip on the propeller. Turn the end of the shaft into a tight hook and sink this into the hub of the propeller. Loop on 18 strands of ⅛ in. flat model airplane rubber (SS) and then cover the bottom of the fuselage with china silk and give three coats of dope.

THE top of the main wing may now be covered with bamboo fiber paper. Glue along the entire edging and outline of the wing, but not on the ribs and spars. Press the cover on smoothly. When it is dry, trim off the margin and give two coats of dope.

The stabilizer is a flat plate covered on both sides with bamboo (*Continued on page 149*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

A Flying Model

(Continued from page 148)

fiber paper. The spar V is white pine 1/8 by 1/8 by 9 1/2 in. The center rib W is 1/8 by 1/8 by 9 1/2 in. It is bradded to the spar and tapered to flush up with the outline. The outline X is bound to the spar ends with thread and glued to the center rib. The ribs Y are 1/16 by 1/16 in. white pine set on edge and forced into place. It is necessary only to glue them as the cover holds them securely.

Cover the stabilizer on both sides with bamboo fiber paper and give two coats of dope. Mount it by driving a brad into the rear spar and on into the sternpost, and another brad through the center rib into the upper horizontal fuselage strut No. 7. The spar must have a block Z 1/8 in. high between it and the fuselage to trim the stabilizer at a neutral angle. The braces, which are best seen in the upper illustration on page 74, are 1/16 by 1/16 in. bamboo sharpened at the ends and glued and forced into knife slits in the lower longerons and the ribs of the stabilizer. Place glue under the brads before nailing down the stabilizer.

The elevators are covered on both sides with bamboo fiber paper and given two coats of dope. Each is assembled in the same manner as the stabilizer. The main rib is bradded to the spar, the outline EE glued and bound and the rib forced into place and glued. The rib DD is 1/8 by 1/8 white pine and the main rib FF and spar GG 1/8 by 1/8 in. white pine (rounded). Each elevator is wired to the stabilizer at three points, HH, thus forming a hinge.

THE rudder post II is 1/8 by 1/8 by 4 in. tapered at the ends to flush up with the outline. It is glued and bradded to the sternpost. The outline KK is bamboo 1/16 by 1/16 by 12 in. Drill a hole into the center rib of the stabilizer 1 3/4 in. from rear spar and glue and force the outline into this hole. Lead the outline over the top of the rudder post, and around, and force it into a hole drilled through the rudder post, carrying it on into the base of the sternpost. Force the rudder ribs JJ, which are 1/16 by 1/8 in. pine, into place and glue. Cover rudder and fin in one operation. Give two coats of dope.

The cowling LL is made from medium grade manila drawing paper. The rear section runs from the nose plate to the struts at station No. 2. Dampen slightly, draw around tightly and glue in place. The nose cowling MM, which is a cone to cover the projecting motor stick, is also made of manila paper. The cylinders NN are 1/4 by 1/4 in. white pine with corners rounded off. The exhaust pipes OO are match sticks glued into holes in the cylinders. Cut the bottom of the cylinders to fit the cowling; then insert a double pointed brad into each cylinder and glue it to the cowling. There are nine cylinders arranged radially. After the glue dries, paint the cylinders black and stretch a brass wire about the circumference.

The ship is lacquered silver and the windows, door, skylight, striping, numerals, lettering and so on are added in flat black.

It is best to make a gliding test before installing the nose cowling. Add weight to the nose by fastening lead to the nose plate with glue until the model will glide to the ground with the elevators at a neutral angle. Make the first flights in tall grass so as not to damage the machine. Always fly the machine with the wind. The rubber may be wound 120 turns.

The adjustment of the elevators is quite delicate and must be carefully watched. If they loosen up, they can be wedged tighter by inserting a toothpick into the hinges. After you get the adjustment, glue them in place.

If the machine shoots up sharply and stalls, push the elevators down slightly. If it fails to climb, push the elevators up a little.

The original model makes a beautiful hand-launched flight of more than 300 feet and takes off the ground on short flights under its own power.

21 JEWEL~Extra Thin

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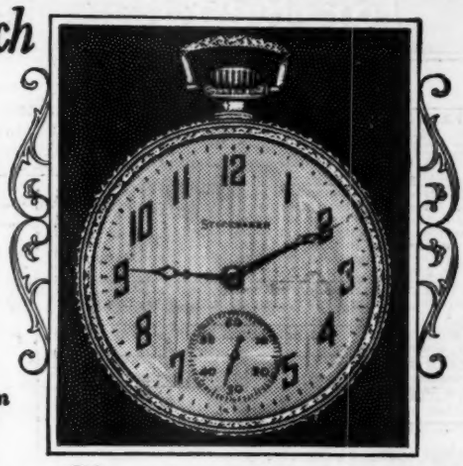

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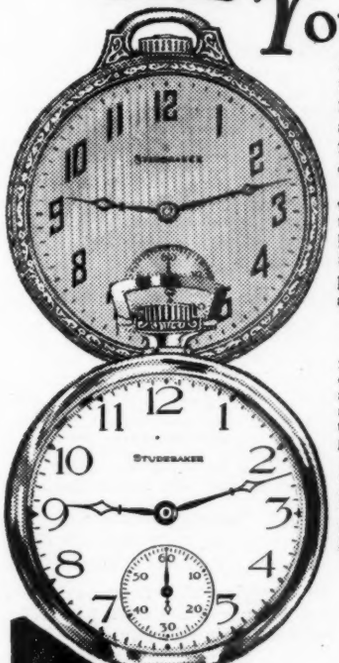

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This amazing offer enables you to pay for your watch while wearing it. Studebaker Watches have 21 Jewels, genuine rubies and sapphires, 8 adjustments—for heat, cold, isochronism and five positions. Insured for your lifetime! Insurance Policy given FREE! Ladies' Bracelet Watches, Men's Strap Watches, Diamonds and Jewelry also sold direct to you at lowest prices and on easy monthly payments. Open a charge account with us. Send the coupon.

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For a limited time we are offering a Magnificent Watch Chain Free. To all who write immediately we will include particulars of this astounding special offer. This offer is limited. Send the coupon at once—before it expires.

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NEW 1928 Book offers finest, newest well-known sets; parts, eliminators, accessories at lowest prices. Set-builders, dealers, agents—WRITE for this CATALOG!

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THIS 100 PAGE RADIO CATALOG FREE

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Radio Specialty Co., 96-P Park Place, New York, N.Y.

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ADVERTISE in 24 metropolitan dailies, 24 words, $15.00. Helpful Guide listing 1000 publications, 4c stamps. Wade Company, Baltimore Bldg., Chicago.

24 WORDS,-151 rural weeklies, $6.04. Ad-Meyer, 4112P Hartford, St. Louis, Mo.

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BIGGEST, Best Catalog Model Airplanes, Parts, Supplies; 5c postpaid. Ideal Company, 163½ Spring Street, New York.

SEND dime for 12 inch mounted propeller and circulars on free three foot model aeroplane. No selling. Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.

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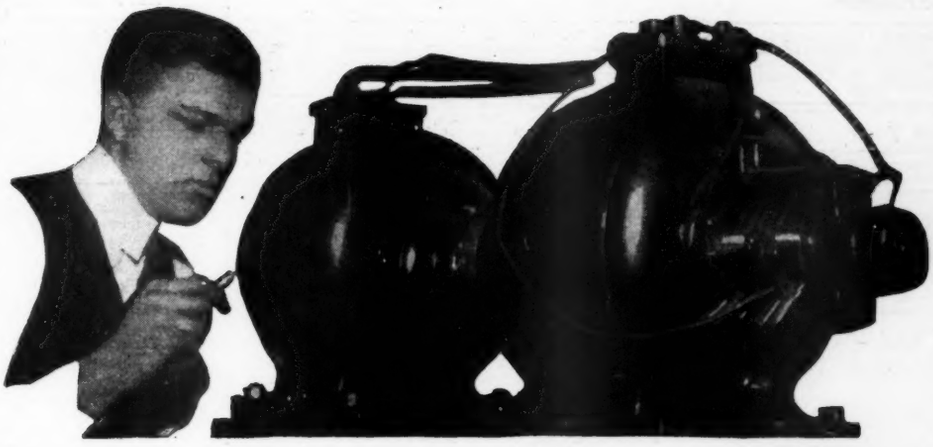

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DETECTIVES—Work home or travel. Experience unnecessary. Particulars free. Write, George Wagner, 2190-P Broadway, N. Y.

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TO THE man who likes to work with tools, Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blueprints available: No. 1, Sewing Table, No. 5, Kitchen Cabinet, No. 13, Tea Wagon, No. 15, Workshop Bench, No. 17, Cedar and Mahogany Chest, No. 43, Four Tube Radio Receiver, 44 and 45, Model Pirate Ship, 46 and 47, Spanish Galleon, 48, Model Sailing Yacht. Send 25c for each blueprint that you wish to Popular Science Monthly, 242 Fourth Avenue, New York, N. Y.

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Yours very truly,
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$30 to $40 A DAY

Made by Agents!

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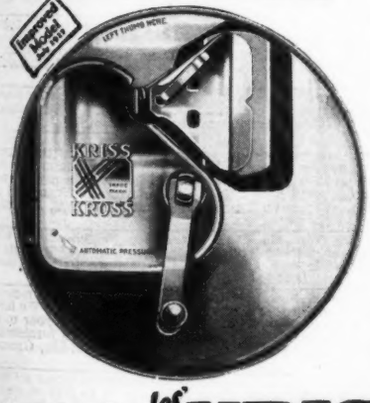
THE amazing experience of Mr. Main is merely the climax of a series of phenomenal revelations made unsolicited by KRISS-KROSS users from all parts of the U. S. A. These astonishing records of service almost stagger belief—yet they have been proved true beyond the shadow of a doubt. What is this sensational device that prolongs the life of any blade for months and years—that eliminates 83% of shaving costs—that gives men the coolest, slickest shaves they ever experienced and ends raking and scraping forever?

The Most Amazing Shaving Invention Ever Patented!

KRISS-KROSS marks such a radical advance in shaving comfort and economy that thousands refer to it as a "Blade Rejuvenator." And no wonder, since it almost literally makes a new blade out of an old one 365 days out of the year! KRISS-KROSS operates on an entirely new principle. It actually duplicates the stropping stroke of a master barber, and with a mechanical precision no human hand could ever attain! Eight magic leather grooves strop your blade (any make except Durham Duplex) **on the diagonal**—an exclusive feature. Pressure decreases automatically to feather-like finishing stroke—another exclusive feature that eliminates guesswork and notifies you of the exact moment when your blade is ready **with the keenest cutting edge that steel can take.** All automatic, just turn a crank. Eleven seconds and you are ready for the finest shave of your life. Can you imagine anything more delightful?



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Why continue longer to deny your face the cool, refreshing shaves it deserves? Why not let KRISS-KROSS serve you as it is serving over 1,000,000 delighted American shavers today? No need to hesitate, especially since by acting at once you can get Free a new kind of razor that will surprise and delight you. This amazing razor is being given for a limited time to introduce KRISS-KROSS. It is entirely unlike anything you ever saw before. Instantly adjustable to any one of three shaving positions—straight, T-shape, or diagonal (new way). The diagonal stroke, exclusive with KRISS-KROSS, cuts beard resistance 45% and will give you a new sensation in shaving comfort. Moreover, being fashioned from one single piece of **rustless** metal, this mystery razor eliminates bothersome care and attention. It comes with five ultra-keen, hollow-ground blades that will last indefinitely. Get yours while this generous offer still holds good. The coupon brings illustrated description and full details without obligation. Mail it today!

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MAKE money in Photography. Learn quickly at home. Spare or full time. New Plan. Nothing like it. Experience unnecessary. American School of Photography, Dept. 1743, 3601 Michigan Avenue, Chicago.

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$1250.00 FOR a Photoplay story by an unknown writer and sold through our Sales Department. We revise copyright and market. Located in the heart of Motion Picture Industry. We know the demand. Established 1917. Send Manuscript for free criticism. Booklet mailed on request. Universal Scenario Company, 214 Western & Santa Monica Bldg., Hollywood, Calif.

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HAMMERMILL Bond Letterheads, envelopes, invoices, statements, or business cards $1 for first 100 each item. Get prices other quantities. All prepaid. C. E. Patton Company, Arthur Bldg., Omaha, Nebraska.

200 SHEETS and 100 Envelopes printed, $1.00. Write for samples. J. Brooks, Printer, Glasgow, Ky.

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HOW to Buy, Install and Operate for best results. A new 20-page booklet published by the Popular Science Institute gives full details that will help you get the most out of your radio investment. Price 25c. Popular Science Institute, 242 Fourth Ave., N. Y. City.

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PECAN—Orange—Fig Groves "On the Gulf." Monthly payments. Guaranteed care. Big, quick returns. Suburban Orchards, Dept. "S," Biloxi, Miss.

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AGENTS—Clever invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Bldg., New York.

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$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

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BIG money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

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AGENTS: Make $500.00 Monthly. Pay daily. No investment. Rhinestone initial buckles and novelties. Sell easy everywhere. Exclusive territory. Chaton Novelty Co., 606 Blue Island, Chicago.

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CALIFORNIA perfumed beads selling like hot cakes. Agents coining money. Big profits. Catalog free. Mission Factory, R2328 W. Pico, Los Angeles, Calif.

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AT LAST! Reasonable priced Auto Emblems for every Lodge. Sells for only $1.25. Write for attractive selling proposition and FREE sample case offer. North Central Distributors, Department 10, Ashland, Ohio.

WALKER made $165 first day selling Collection System to doctors and merchants. Retails $6.50. Collects $65.00, costs $1.50. Adjustment Assn., Mobile, Alabama.

JUST Out—New Patented Apron. No strings or straps—$20.00 a day every day; over 100% profit; commissions daily. Write for free offer. Sta-Put Co., Dept. 910, St. Louis, Mo.

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FROM the Argentine, South America. Latest Novelty, marvelous sales possibility, most unusual, write for full particulars. Write Don Francis X. Cannon, Dept. 117, 23 Washington St., New York City.

REPLATE brassy worn-off automobile parts, reflectors, bath room fixtures, worn spoons, forks, etc., with pure silver. Looks like new. Use U-Kan-Plate Polish. Positively no mercury. $1.00 half pint. Postpaid. Satisfaction guaranteed. Agents wanted. Dept. 3. U-Kan-Plate Co., Philadelphia.

MAKE $100 a week up, selling better-quality, all-wool made-to-measure suits and overcoats. Big values. Highest commissions, paid in advance, and extra bonus for producers. Large swatch samples furnished free. Write W. Z. Gibson, Inc., 161 W. Harrison, Dept. K-521, Chicago.

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WONDERFUL new moisture gas saver. All cars. 400% profits. Doubles Mileage. 1 free. Crittenden, A1-120, Wheaton, Ill.

MAKE $1000 before Christmas selling exclusive personal Christmas cards in distinctive steel engraved designs. Expensive sample book free. Wetmore, Jaun and Sugden, Rochester, N. Y.

LAMB'S Wool polishing mittens, brushes. Newhall, 358 Broad, Lynn, Mass.

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WANT $15 A Day? New way to make quick cash selling fine shirts. Actual samples sent free. Write Fashionwear Shirt Co., M-363 Jackson St., Cincinnati, O.

AGENT: Be a thousand miles ahead of competition. Patented product housewives want. 100% profit. Commission in advance if wanted. Manager Box 929, New Orleans, La.

IF you can devote two to four hours an evening to profitable spare time work, write us at once. We pay $2.00 to $4.00 an hour. No experience necessary. Nason Company, Dept. 10-ZM, Covington, Ky.

MAKE $25.00 daily selling colored Raincoats and Slickers. Red, Blue, Green, Etc., $2.95. Hat Free. Commissions daily. Outfit FREE. Elliott Bradley, 30 Van Buren, Dept. AC-10, Chicago.

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AGENTS $180 month. Bonus besides. Introduce finest line guaranteed hosiery. 126 styles, colors. For men, women, children. Finest pure thread Japanese Silk. All fancy combinations of silk and lisle. Novelty and Sport numbers, full fashioned, chiffon, wool, etc. Must wear 6 months or new hose free. New sales plan. Credit given. Auto furnished. Spare time satisfactory. Write for samples. Wilknit Hosiery Co., Dept. 3031, Greenfield, Ohio.

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MAN between 25 and 65 to act as manufacturer's agent. No investment necessary. A man with selling experience or willing to learn, who can command respect and who is willing to work, will find this a permanent business, with a steady income of from $175 to $425 a month. Write to Thomas N. Judy, Box 966, Dayton, Ohio.

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AGENTS $240 month. Bonus besides. Introduce finest line silk hosiery. Guaranteed 7 months. We furnish auto and give you fine silk hosiery for your own use. New plan gets business fast. Samples furnished. Write quick. Betterknit Textile Co., Silk-832, Greenfield, Ohio.

MAN with car can build up valuable trade selling and delivering Paste Hand Soap direct to dealers, also agents, etc. Prices and goods guaranteed right. The Connecticut Can Co., Hartford, Conn.

SALESMAN selling to men. We have side-line for you that will sell along with any other line you may now be handling and make more money for you, provided you are now selling to men. Get full facts at once by addressing Salesmanager, 850 West Adams, Dept. 189, Chicago.

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$40.00 SUITS for $23.50! All one price. Union made of finest quality Virgin Wool. You don't have to know anything about selling clothing. We guarantee your success if you are honest and willing to work. Write at once. William C. Bartlett, 850 Adams, Dept. 568, Chicago.

AGENTS—Fred Chapdelaine made $70.00 one week. Start your own business. Make 100% profit. New magic powdered hand cleaner. Entirely different. Washes hands cleaner and in half the old time. A man's job. Big repeater. Free samples furnished to be given away. Write for free trial package. P. Magnus Chemical Co., 728 Atlantic Ave., Brooklyn.

SUCCEED With Your Own Products. Make them yourself. Formulas, Processes, Trade-Secrets. All lines. Catalog, circulars free. C. Thaxly Co., Washington, D. C.

GREAT neckwear line now free! Features finest quality neckwear at factory prices. Collect big commissions daily. Write for FREE tie offer and FREE outfit. Naweo Neckwear, Desk 10-ZN, Covington, Ky.

AGENTS—Big Seller—$20 Daily Easy selling Taylor Caps—made-to-measure—every man buys—some want 2 or 3 caps. Samples Free and Cap free to agents. Write quick for fast money making proposition. Taylor Cap Manufacturers, Dept. A-81, Cincinnati, Ohio.

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YOU are wasting time working for other people. Let us show you how to control your own business and make $100 a week. Capital unnecessary; immediate profits. American Products Company, 9452E Monmouth, Cincinnati, Ohio.

AGENTS—Startling new automatic device banishes can openers! Patented. Absolutely unique. Holds can on wall. Simple turn of crank cuts top out clean. Sells fast. Write for Free Test Offer. Central States Manufacturing Co., Dept. M-1041, 4500 Mary Ave., St. Louis Mo.

OWN your own business. Inexperienced workers, spare time or full time, build profitable business with our new plan. Show marvelous line of actual shoes. Men's, women's and children's. Also durable silk hosiery. We start you by furnishing $40 sample outfit. Patented measurement system insures perfect fit. Every day pay day. Larger variety of styles and sizes than any store. If you want a permanent business, send for free book "Getting Ahead." Write now. Tanners Shoe Manufacturing Co., 3710 C Street, Boston, Mass.

SELL Wonderful Hand Adding Machine. $1. Wholesale. Retail, $4.50. Typewriter Supply, 104 Hersch Bldg., Pittsburgh.

AGENTS make $100 week placing Cigar Lighters with glass advertising front. Free Plan. Drake Mfg. Co., Dept. F., Milwaukee, Wis.

AGENTS—Biggest hit of season—FitsU adjustable Caps and Mufflers to match. $1.70 commissions in advance on every confirmation order. $10 to $20 a day easy. Write quick for free outfit and free cap offer. FitsU Cap Co., Dept. CL-75, Cincinnati, Ohio.

AGENTS—Sell New Confectionery Specialties to stores—big profits—constant weekly repeat orders—exclusive sales right. Box 971, Richmond, Virginia.

TAKE orders for coffee, flour, dried fruits, canned goods, meat, staple groceries, toilet articles, paints, tires, auto and tractor oils. No capital or bond required. We deliver and collect. Permanent business. Big pay. Write at once. Hitchcock-Hill Co., Dept. 81, Chicago.

PHOTO Medallion agents earn $20 daily. Easy work collecting photos. Big line; quick sellers. Capital or experience unnecessary. Give you 4-day service on beautiful photo reproductions. Reserve your district today. Write Pudlin Corp., Dept. 105, 259 Bowery, New York.

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EVERYTHING for Battery and Tire Shops at wholesale. Send for our new complete catalog. Adams-Barra, Columbus, Ohio.

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PACIFIC Coast Representative for Eastern Manufacturers. Experienced. References. Box 71, Seattle, Wash.

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OLD coins, large Fall selling catalogue of coins for sale free. Catalogue quoting prices paid for coins, ten cents. William Hesslein, 101B Tremont Street, Boston, Mass.

CALIFORNIA gold $\frac{1}{4}$ size, 27c.; $\frac{1}{2}$ size, 53c. White cent and catalogue, 10c. Norman Schultz, Box 746, Salt Lake City, Utah.

A SIAMESE CHARLESTON

These three professional dancers are considered pretty good in Siam. Here they are shown giving, for the benefit of the camera, their own version of the American Charleston

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World Travel With All Expenses Paid!

How often you've longed to see for yourself the awe of Egypt's pyramids—the beauties of the gorgeous Mediterranean sunset—the squalor of China's ancient cities! Now you can do it—travel the whole world at will, all your expenses paid. Every one of your expenses of travel will be paid for you—you won't be out a cent of your own. And you can draw a good salary besides!

There is a big demand for men to handle the Radio operating on board the ships of the world. Practically every vessel must carry one man—many of them two or three or more. Radio operating is easily and quickly learned—and the work is very interesting and pleasant. There is no other work like it for the man who wants the experiences and pleasures of world-travel.

Radio operators aboard ocean liners live luxuriously—they rank as officers of the ship. Meals, a private cabin, all other living needs are furnished free, and besides, the operators draw a good salary. You don't have to sign up for a long term—you can change ships as often as you like, so as to go to any part of the world you prefer on each voyage.

Book with Full Information Sent Free

My free 64-page book gives all information about this field of work, and the opportunities for travel, fascinating work and advancement. Send for it today—get all the facts. You can learn in your spare minutes at home to qualify for a Radio Operator's position. Just a few months of my practical training in your spare time at home and you'll be prepared to start on your travels.

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No special education is necessary—lots of men I've trained didn't even finish the grades. Read about it for yourself in my big free book—learn how I'll prepare you quickly and easily at home for these big opportunities.

Send the Coupon TODAY! Address: J. E. SMITH, President, National Radio Institute, Washington, D. C.

The "Sailaway" Coupon—Mail it now!

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Dear Mr. Smith: Please send me your free 64-page book, with all information about learning Radio for bigger pay, and as a means to world-travel at will, all expenses paid. I understand this places me under no obligation.

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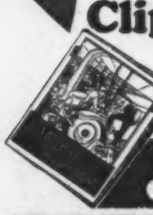

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MINT—$5 revenue free to applicants with references. Foreign revenues, telegraphs, locals, etc. Intriguing, educational, different, cheap. E. R. Vanderhoof, 1114 Logan Street, Denver, Colorado.

500 DIFFERENT 40c; 1000, 80c; 2000, $3.50. Fred Onken, 630 79th Street, Brooklyn.

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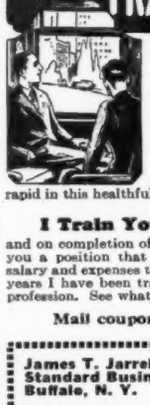

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You may send me entirely free, your booklet No. Div. 3 showing how I can earn $250 a month salary.

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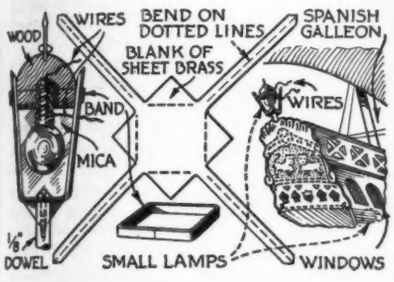
How to Install Lights in a Ship Model

By James E. Tomlinson

BY THE exercise of a little ingenuity, you can provide lights for any ship model. The lantern illustrated, for example, was made to fit the Spanish galleon model designed by Captain McCann for Popular Science Monthly (Blueprints Nos. 46 and 47, page 102).

To make one like it, lay out the pattern on a sheet of light copper or brass, cut it out and place the piece in a vise, one diagonal at a time, in such a way that you can turn over the edge of the metal by tapping it lightly with a small hammer. Turn up the arms with the right-angled channels inward and turn down the triangular tabs to form an ornament at the lantern base.

In the center of the square, drill a hole to take a small screw. Cut a strip of the copper or brass ⅛ in. wide and 4 in. long.



Ornamental lantern with flashlight bulb for the Popular Science Monthly galleon

Bend and solder to form a square, slip it on the lantern frame, and solder lightly in place.

With a hot iron of the right size, bore a hole in a ⅛-in. wooden dowel to receive the screw after binding the dowel with light copper wire to prevent splitting. Cut mica panels to fit inside the channels and tint them amber with light varnish stain. Strengthen the top by soldering small strips of lead at two corners. Cut a deep round button mold to fit in the top tightly and burn a hole to receive the base of a flashlight lamp. To meet this, bore another hole for receiving one of the wires. Finish the top with a spike of wood.

Solder two light copper wires to the lamp as shown and place it in position by threading the top wire through the proper hole and pulling it tight. Put in the mica panels and glue the top on. Then gild and polychrome it with oil paint, if you wish.

Similarly, real instead of imitation windows can be placed in the ship itself. Paint the edges of the openings and cover the outside with mica, upon which crossbars may be painted. Flashlight bulbs then may be placed in the cabins. It is necessary, of course, to cut doors to allow the lamps to be inserted.

Round bulbs may be used as riding lights, if suitably crossed with black enamel. The screw threads may be filled with gesso and smoothed over neatly.

Anchors that are a welcome substitute for the clumsy cast anchors so often seen can be made of bus wire such as is used in radio construction.

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O. C. Miller

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The American School now offers its students and graduates, without cost, the services of an efficient Employment Department which keeps in touch with the employers of Draftsmen all over the United States. *We have placed hundreds of men in good Drafting positions.* We have made this training so complete, so practical, so easy to master, that our students *are bound to make good.* And, so, because the demand for real Draftsmen continues to exceed the supply and because this training actually prepares men for good Drafting positions, *we back it with a Free Employment Service, free to employers, students, graduates.*

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Fine, imported instruments help you learn Drafting easily and quickly. These standard quality, full size instruments, including board, table, triangles, T-square, ink, protractor, etc., given without extra charge to students.

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Without cost or obligation, please send me a copy of your booklet, **"Who Wins and Why,"** and full particulars about the course *before* which I have marked X:

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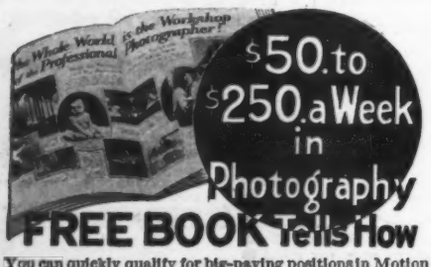

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How to Get into Aviation

(*Continued from page 11*)

Commander BYRD: For a license as an industrial pilot you must have had at least fifty hours of solo flying. That doesn't mean that you were alone in the plane, but that you were in command and operated the controls alone. An industrial pilot's license entitles you to carry merchandise or mail. A limited commercial pilot's license allows you to carry passengers for hire within a limited area, generally ten miles from a fixed base; to get it you must have had fifty hours of solo flying. A transport pilot is the only one allowed to carry passengers. He must have had at least 100 hours of solo flying.

Mr. GUFFIN: How can I get enough flying experience to qualify for one of these pilot licenses after I have got my diploma from the flying school?

Commander BYRD: There are several ways. One is to hire a plane by the hour, being careful not to fly it across a state line.

Mr. GUFFIN: What will that cost me?

Commander BYRD: You can pay as high as $25 an hour, or you can join one of the flying clubs they are organizing all over the country. In these clubs, several persons who want to learn to fly buy a plane together, hire an instructor, and use the plane in turn. That cuts the cost per person to three or four dollars an hour. But if you can qualify for the Air Reserve, the Government will arrange to give you flying time in Government planes.

Mr. GUFFIN: What other ways are there for me to get in the required number of hours in the air?

Commander BYRD: If you are lucky enough to get a job around a flying field, where you can exchange your services, or part of them, for the occasional use of a plane, that is a good way. Or if you have the price and a place to keep it, you could buy a plane.

Mr. GUFFIN: Wouldn't that cost more than hiring a plane by the hour for fifty hours?

Commander BYRD: Yes; but when you had got a license for your plane and for yourself you would have something to do business with on your own account. You can buy a pretty good plane for as low as $2,000. In fact, you may be able to pick up a rebuilt wartime plane with a serviceable engine, for much less than that. But if you do buy a cheap plane, be sure it will pass the Government inspection and be licensed, before you pay anything on it.

Mr. GUFFIN: I could build a plane myself, couldn't I, by buying the parts and the engine separately?

Commander BYRD: Yes, but I wouldn't advise you to try it. You probably could make something that would fly, but I doubt that you could get a license for it. The engineering skill that goes into even a small modern plane is far higher than that required to build an automobile.

Mr. GUFFIN: What could I do with a plane of my own, to make a living?

Commander BYRD: You could do a number of things. There's a growing demand for air "taxi" service, carrying passengers outside of established air routes. In the future there will be much more business than at present in carrying express parcels by air. You might pick up a short-line mail contract, a "feeder" line to connect with one of the through air mail routes. There's nothing to stop you, if you have the right sort of plane, from running a regular passenger or express service of your own over the established airways; the airports are free to all flyers. There's always the opportunity to take up passengers for short "joy-rides." And if you become expert enough, you could start a little aviation school of your own, teaching others to fly.

Mr. GUFFIN: But to do any of those things I would have to have my own landing field, hangar, mechanics and such accessories, wouldn't I?

Commander BYRD: Not at all. There are several thousand landing fields in the United States, several hundred of them municipally owned, and many of them having equipment and service arrangements available to any airman at a moderate fee.

Mr. GUFFIN: I'm interested in photography. Is there a good future in aerial photography?

Commander BYRD: Decidedly, especially in aerial surveying. An aerial camera is expensive, but its use is increasing very rapidly, and I believe eventually most of our surveying and map-making will be done from the air. They tell me the Brock aerial camera, for instance, does more accurate work than Government topographers.

Mr. GUFFIN: If I learn to fly and qualify for an industrial or transport pilot's license, but can't afford a plane of my own, what is my chance of getting a job as pilot?

Commander BYRD: It depends a lot on yourself. In general, I should say that with commercial aviation developing as it now appears to be, a first-rate pilot should never have any trouble in getting a job with one of the air transportation companies.

Mr. GUFFIN: How many concerns are there who employ pilots or men in other branches of aviation?

Commander BYRD: I don't know that anyone can answer that question precisely. A dozen or more companies have mail contracts over some twenty mail routes. Many of these are building planes to carry express matter and passengers. One of the big express companies is planning to develop an air service. New mail routes are being established, which means more contracting companies, more planes and a need for more pilots. No doubt these and other commercial activities in the air will increase more rapidly in the next few years than ever before. You'll have to get into the atmosphere of aviation and feel your way for a while, before you find the opportunity which will fit you best, but I think you will make no mistake, if you are in earnest about getting into flying, in going at it seriously as a life career. But you can't get to the top in one jump.

Mr. GUFFIN: How much time do you think I'll have to spend in "feeling my way," as you say, before I am making as good a living as a locomotive engineer, say, or the captain of a steamer?

Commander BYRD: That's another thing that depends on your own special aptitude and initiative. I wouldn't expect a young man to make more than a bare living for the first two or three years, as a pilot. I think he can reach the point of self-support and a surplus more quickly in some of the other branches of commercial aviation.

Mr. GUFFIN: As an airplane mechanic, for instance?

Commander BYRD: That's a good trade and getting better, now that the Government is requiring every airplane mechanic to be licensed. That is, no licensed airplane can be overhauled or repaired by anyone except a licensed mechanic. The top pay is not so high as a pilot can earn, but for a young man mechanically inclined, it may lead to very good opportunities in the building of planes. If he has an engineering training, his opportunity is larger.

Mr. GUFFIN: How would you suggest I go about getting into that line, if I decided I want to take it instead of piloting?

Commander BYRD: The only way I can suggest is to get a job in an aircraft factory and put the best you have into it; unless you have the means and the qualifications to take the full course in one of the

(*Continued on page*

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How to Get into Aviation

(*Continued from page 158*)

universities which teach airplane engineering.

Mr. GUFFIN: Can I do that? Are there universities which specialize in airplane engineering?

Commander BYRD: Yes, indeed; and some of them go into the subject very thoroughly—for instance, the Massachusetts Institute of Technology, New York University, the University of Michigan, Leland Stanford University and the California Institute of Technology.

Mr. GUFFIN: What would I have to do to take one of those courses?

Commander BYRD: You'd have to pass a college entrance examination for the course in mechanical engineering. That means you'd have to be very good in mathematics, especially. At New York University—and I suppose at the others a similar rule prevails—you'd spend your first two college years in the regular mechanical engineering course. In your third year you'd get one added course, in the fundamentals of airplane theory and design, and your fourth year would be almost entirely in various phases of aeronautical engineering. While in college you'd get a chance to learn to fly, through arrangements with the Army and Navy Air Corps Reserves.

Mr. GUFFIN: After I got through that university course, what would be the opportunities for me?

Commander BYRD: Aeronautical engineers are in great demand by airplane builders. I believe this demand will continue to grow. You'd have to start at perhaps $40 or $50 a week, but if you had special aptitude for the work you could soon earn much more, and if you developed original ideas for plane construction, and they proved successful, you might eventually become the engineering head of some big company.

Mr. GUFFIN: Is there any way I could get part-time instruction in these engineering courses while working daytimes, either in an airplane factory or in some other job?

Commander BYRD: Yes; New York University has courses in the evening in Industrial Aviation and in the Elements of Aerodynamics and Airplane Design. These are open to everybody at a low fee. I don't know of similar courses given elsewhere, but presume there are or will be such courses at other universities.

Mr. GUFFIN: You spoke several times of other occupations in commercial aviation. What are they?

Commander BYRD: Think of commercial aviation as an organization like a railroad. That's the best way to get an idea of how we are developing flying in this country. You know the operation of trains is only one part of a railroad's business. Trains run on tracks; airplanes run over regular airways, or at least a large part of commercial flying is done over these airways. There are airports to be maintained and operated, just like railroad terminals, with emergency landing fields along the airways, and beacons to be kept lighted for night flying. At the airports there are the radio direction apparatus, sending out signals to guide flyers at night or in bad weather, the beacons and flood lights to be attended to, hangars, mechanics for repairs, oil and gas supplies, and an organization for handling passengers and freight. That adds up to a lot of different kinds of jobs besides flying. Then the airplane companies have to go out after business, just as the railroad and steamship companies do. That means advertising, personal solicitation of business, and organizing traffic just as the railroads do it. More jobs. Add to that the designing and building of the planes themselves, and you see there are twenty, thirty, perhaps forty non-flying jobs for every pilot's position.

Mr. GUFFIN: Are most of those jobs filled by men with experience as pilots?

Commander BYRD: (*Continued on page 161*)

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How to Get into Aviation

(Continued from page 160)

By no means. Many of them have no pilot relation to flying; many are positions in which few pilots would fit. But the more a man knows about every phase of aviation, the better qualified he is for any of these jobs, and the more certain his chance of advancement.

Mr. GUFFIN: What do such jobs pay?

Commander BYRD: There are no standards yet. I should say they ought to pay, on the whole, better than similar work for railroad companies. The real opportunity for an ambitious young man like you is to make a job for himself, using his initiative and imagination to do something nobody else has done, or do it better than anyone else can do it. I'm sure there are good jobs waiting for men who can find ways to get business for the existing air transport lines, or to handle that business better than it is now being handled. That, like everything else, in aviation or any other pursuit, depends on the man himself. Nobody can do anything for anybody else except give him advice, and I'm afraid I haven't given you much of value.

Mr. GUFFIN: Commander Byrd, you've given me just the information I was looking for, and I want to tell you how much I appreciate your taking the time to answer all my questions.

Answers to the Sam Loyd Puzzles on Page 66

Cheese and Imagination

The cheese is divided into two pieces by the first cut; into four by the second; eight by the third; fifteen by the fourth; twenty-six by the fifth, and the grand total, forty-two, by the sixth. Fifteen minutes.

Guess This Word

The word AY is changed, by prefixing different letters, to NAY, GAY, JAY, RAY, BAY, DAY, FAY, MAY, HAY, LAY, PAY, WAY and SAY. Ten minutes.

An Arabian Lunch

My payment of eight pieces of silver for 2⅔ loaves of bread established the value of a loaf as three coins. Therefore, the man who contributed five loaves, having a value of 15 coins, was entitled to a return of seven coins, which left one, the proper amount, for the man who contributed three loaves. Fifteen minutes.

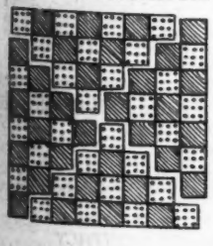
An After-Dinner Test

Pick up 2 and 3 and place at head of line touching 1. Pick up 5 and 6 and fill space left between 1 and 4. Pick up 6 and 4 and place at head of line, and the feat is performed. Ten minutes for the solution is excellent.

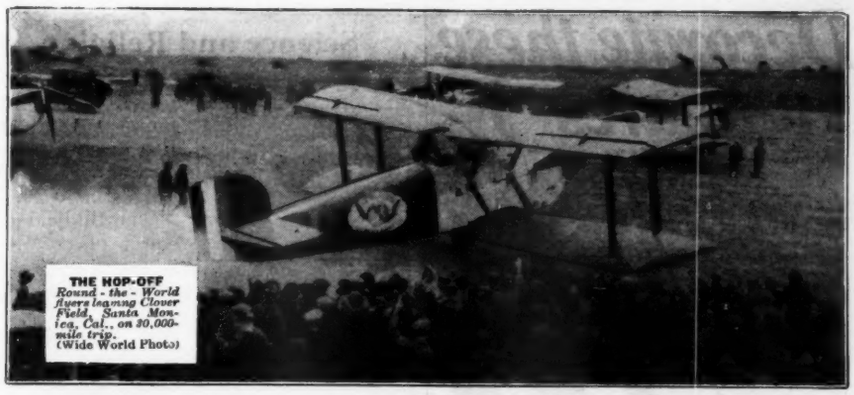
The Cost of a Villa

One fourth of Mrs. Smith's money, or one third of her husband's, or one seventh of their combined funds, would buy that shady grove and babbling brook. The other six sevenths comes to $6000, so that one seventh—the price of the grove—must have been just $1000. Eight minutes.

A Present for Grandma



The diagram at the left shows how the remnant of cloth is cut into four parts of the same size and shape to form the square shawl. Fifteen minutes to solve this is good time.



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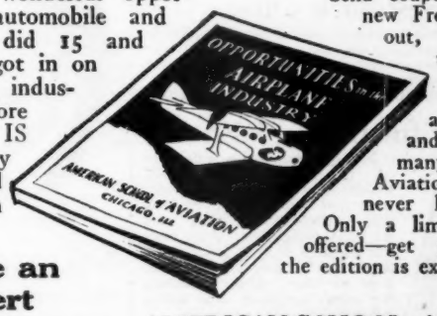

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Science and Religion

(*Continued from page 13*)

Dr. Frank Crane

unknown is infinite, and the farther we go, the farther we find we have still to go.

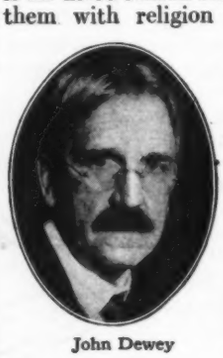
The Biblical account of creation is not anti-evolutionary. It simply speaks of things that God is supposed to have done. It does not say how He did them. The scientists' discovery was merely the discovery of the manner in which God works. Science found out that the Creator grows things, but does not make them. God builds a tree by making the oak grow out of the acorn. That is His process. And there is nothing antagonistic in it to the Biblical account.

The Bible is not a scientific book. It was not intended to increase our knowledge. It is to enspirit us. This it does.

John Dewey, LL.D., Ph.D.

Professor of Philosophy, Columbia University

IN MY judgment the whole enterprise of reconciling science and religion is a mistaken one. It is the business of an intelligent person to have the kind of religion which does not need to be harmonized with science. He should accept the findings of inquiry based on the best evidence available, irrespective of their bearing upon traditional beliefs which have got entangled in creeds and the religious documents connected with ecclesiastical groups. These beliefs represent merely the speculations of persons when there was not the basis for conclusions as to matters of physical, biological and historical facts which now exists. There is no more reason for trying to reconcile them with religion than there is for attempting to harmonize the science of the second Century of our era with the science of today.



John Dewey

Applying this idea to a particular case, I should have no more interest in harmonizing the facts regarding the astronomical and geological history of our globe, including its formation and the origin and the development of living forms, with the poetic legends of early Semitic people than I should in "reconciling" them with the creation-myths of the North American Indians. It is a mistake to think of "science" as something in itself which is a fountainhead of truth. It is only a name for the conclusion substantiated by the most thorough, extensive and impartial methods of inquiry available. There is no rival method of arriving at the facts and truths with which science

(*Continued on page 163*)

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Science and Religion

(Continued from page 162)

deals. A man may accept the findings of science and may still be sincerely religious provided he realizes that religion is concerned with moral and spiritual attitudes, with aspirations and ideals, and not with the physical, biological and historical facts which fall within the province of independent and free inquiry.

Daniel C. Beard

Artist; Author; National Scout Commissioner, Boy Scouts of America

I DO not see where there can possibly be a conflict between religion and science—I mean the religion of the Fatherhood of God and the Brotherhood of Man—except where science is blind to spiritual things and where seriously religious people are equally blind to the spiritual meaning of the Scripture.

Daniel C. Beard

Many churches have fenced themselves in with high walls of man-made dogmas and creeds, but dogmas and creeds must not be mistaken for Divine institutions; nor must everything that science declares be accepted as infallible, for tomorrow other scientists will no doubt disapprove many things accepted as facts today. Science does and should deal with material things and the churches with spiritual things but they should cut some peepholes in their high walls of dogma and see the awe-inspiring greatness of God's universe, outside the back yards of the churches.

Arthur Capper

U. S. Senator from Kansas

THE truths of science and of religion belong to different realms and come through different faculties. The faculty of spiritual experience is disputed by some scientists, but many of the greatest recognize it. Lord Kelvin said: "If you think strongly enough, you will be forced by science to believe in God." Appreciation of the logical limitations of science induces belief in God.

Arthur Capper

As to the sketch of creation in Genesis, people who must take it as describing distinct acts of creation for every existing species, cannot reconcile it with evolution. Otherwise there is no conflict. If dogmatists in science tried to prescribe once for all what must be believed and religion did the same, there would be no harmony. Science and religion are not in conflict; science and creeds may be.

(Continued on page 164)

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And you can learn the BIG PAY profession of electricity right in New York City—the heart of the electrical world—the city of 100,000 jobs. At the same time you are learning the BIG PAY profession you can be enjoying the sights and wonders of New York, the modern Bagdad.

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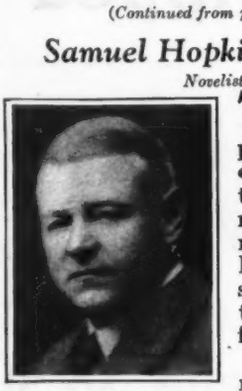
Science and Religion

(*Continued from page 163*)

Samuel Hopkins Adams

Novelist



Samuel Hopkins Adams

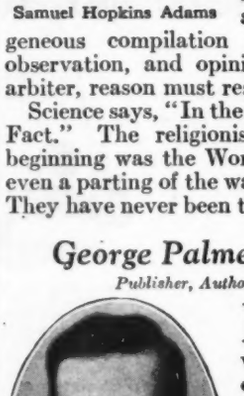
THE scientific and religious positions are irreconcilable. This is the fault not of religion, but of the religionists. They have made the spirit subservient to the letter, the fact to the word.

From the moment the Bible or any other heterogeneous compilation of commentary, observation, and opinion is made final arbiter, reason must resign the debate.

Science says, "In the beginning was the Fact." The religionists say, "In the beginning was the Word." There is not even a parting of the ways between them. They have never been together.

George Palmer Putnam

Publisher, Author, Explorer



George Palmer Putnam

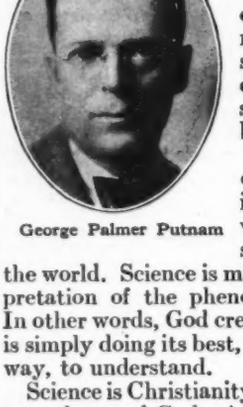
IT IS my belief that people who cannot reconcile science and religion are too stupid or too uneducated to understand either or both.

Christianity's conception of God is that of an invisible super-person who created the world. Science is man's gradual interpretation of the phenomena of Nature. In other words, God created what science is simply doing its best, in a slow faltering way, to understand.

Science is Christianity's greatest chance to understand God. And every step upward in science accentuates the supreme artisanship of the Almighty.

Royal S. Copeland, M.D., A.M., LL.D.

U. S. Senator from New York



Royal S. Copeland

MY YOUNG son said: "Papa, I can't make up my mind whether to follow science or religion." I countered with this question: "Why not follow both?"

Assuming the divine origin of the Biblical account of creation, what essential thing is there in it which can be disproved by the scientist? Assuming the correctness of the scientific theory of evolution, what is there in this to shock the religionist?

A scientist can be a true religionist; a clergyman a follower of science.

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Haven't you often wished that you could draw cartoons, illustrate some idea, sketch some pretty face, etc.? You can do all of these things. One of America's most famous Cartoonists and Illustrators has developed a great, simple system for success in all branches of Commercial Art. This system has revolutionized the entire theory of drawing. It means that drawing can be as easy for you as writing—much simpler than learning shorthand, bookkeeping or typewriting. We are now placing this original system for learning Drawing, Art and Cartooning, consisting of 34 lessons with over 500 illustrations, within reach of every one. If you will devote a few hours each week to the Course WE ABSOLUTELY GUARANTEE that you will learn to draw and draw well before you have half finished the Course. If we fail to make this claim good, we will refund every cent paid us. By eliminating a large office force for answering correspondence, expensive catalogs, etc., we are enabled to make a price of $2.98, the cheapest price ever known for a high-grade, home study course. Many have sent us letters similar to that of Rob't P. Davis of Detroit, who wrote: "I can't see how you ask so little, when others with inferior Courses get from $20 to $60 for theirs. It is more than I expected." Learn to draw. It is a big asset, no matter what field you are in.

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Is what V. Strandberg, Minn., sold in 1925. Last year he sold 3800 boxes. Many of our agents in a short time earn large sums of money selling our Christmas Greeting Cards in Box Assortments. We publish a **Magnificent Christmas Box Assortment,** containing 21 high-grade Christmas cards and folders, Steel Engraved, Colored, Paneled and Bordered, each with an envelope, which sells for $1.00 and costs our agent 50c. A value never equaled.

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—will start you on the road to success. See Money Making Opportunities on pages 150 to 182.

Modern Magic in Light

(Continued from page 31)

street—at least not by virtue of its street lamps, which are relatively few and faint. It owes its brilliance—uneven and confused—to a multitude of commercial signs, especially those that blink and jiggle from lofty points of vantage. State Street, Chicago, is the best lighted street in America and perhaps the world from the standpoint of rationally planned, even illumination.

SOME visitors are favored with a trip through the factory where we see the whole fascinating process of lamp making from the blowing of molten glass to the inner frosting of bulbs and the coiling of tungsten filament wire. The first impression is of large quiet spaces, with a casual distribution of machines and a striking scarcity of human operators. A dozen girls and two or three men seem to be the total personnel in one department. Yet production is at full blast. This is the triumph of modern machinery which has dispensed with scores and even hundreds of human hands.

The second impression is that everything revolves. Every machine with all its parts demonstrates the first law of the cosmos, which is revolution. It rolls with stateliness on its vertical axis while a host of satellites spin and gyrate at higher speeds. It is the perfect measured dance of planets and of atoms.

We perceive gradually another motion—the reciprocal or back and forth movement. Used sparingly, it plays a vital part. Vital indeed seem those metal fingers that pick and push and squeeze and withdraw and do a hundred tricky feats.

In a basement are bins of a grayish fine sand, nitre, sacks of white lime and a few other materials for making glass. On the floor above are half a dozen furnaces, each with a capacity of 150 tons of glass. Fuel oil has superseded gas as heat source. It takes three weeks of gradually increased heat to put a furnace in operation—otherwise the sixteen-inch walls of fire clay brick would fail—and once going it is kept at a temperature around 2700 degrees Fahrenheit for a year or so. Glass is made continuously day and night, except Sunday.

IN FRONT of each furnace stands a revolving turret. Metal fingers reach into a pool of white hot glass, withdraw two incandescent viscous lumps and deposit them in a pair of moving cups in the turret. The white lumps elongate by gravity, a puff of air makes them pear shaped, then they are encased in a mold of divided halves and blown to full size. They emerge instantly as red-hot bulbs which roll away on an asbestos belt and pass the test of a coldblooded mechanical critic. The machine produces 64,000 bulbs in its twenty-four-hour day.

A lamp-making machine takes bulbs, bits of glass tube, filament, socket bases, and converts them into lamps at the rate of 2500 a day. A crew of five girls feeds such a machine.

Arabian Nights? Here is all kinds of magic more fascinating, genuine and useful.

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Then Get Into The Big Pay Field

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$70 to $200 a week is made by thousands of "Cooke" Trained Men

You can do as well. Now you work for $20—or $25—or $30 a week. In the same six days, as a "Cooke" Trained Electrical Man, you could be making $70 to $200 a week—and do it easier—not work half as hard as you do now.

Why, Then, Stick to Starvation Wages?

Why hang on to poor-pay work that offers no future, no promotion, no Big Pay? You can't make Big Money there. Get into Electricity. That's where the Big Money is—because Electricity is the fastest growing industry in the world!

I'll Train You In Spare Time

With my now famous "Work Sheet" and "Job Ticket" Methods, I'll train you at home in your spare time. You work just as you're working now—at your regular job. But you learn Electricity every day. And you learn RIGHT, because you learn by **doing**. My methods are work-shop methods. You get practical training from me—training that fits you to tackle the Big Jobs—the jobs that pay Big Money. And not only that, but—

$30 A Day
"I was making $25 a week when I enrolled. Now with my own Electrical Shop I make as high as $30 a day."
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You Earn as You Learn

You don't have to wait a year to "cash in" on my training. Practically from the start I tell you where to get little spare-time electrical jobs, and show you how to do the work. Thousands of my "boys" make $10 to $30 a week extra this way. So can you. And I furnish, without extra cost, Six Big Outfits of Tools and Apparatus—everything you need to learn **right** with, and to do any kind of spare-time electrical work.

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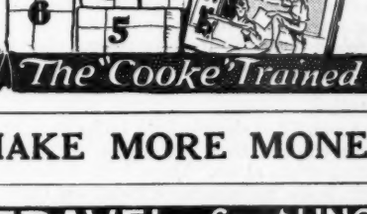
ACT NOW!



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FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

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.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
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Our Future Cities

(Continued from page 22)

On the streets, surface trolley cars will have disappeared entirely, along with telegraph poles, sidewalks, lamp-posts, and everything else that will impede the stream of traffic. On many streets only pedestrians will be allowed. At least three distinct varieties of automobiles will doubtless be in existence. Small, light cars, more like the French cycle cars than most automobiles in use in this country now will probably be common. Large vehicles for carrying passengers—or trains of such vehicles—will probably survive as the descendants of the present-day buses. And huge commercial cars, perhaps, also more like small freight trains than like the trucks of today, will be carrying food, building materials and merchandise. For shorter hauls there will probably be traveling freight-ways, while escalators and moving sidewalks will also be common.

Airships, in all likelihood, will change the appearance of the city more than any other one thing. The great apartment houses of the future will probably be flat, to accommodate airships. Centrally located, as the railroad terminals are today, there will be huge air docks for the trans-Atlantic air liners. These liners will probably be of two types—fast, passenger-carrying heavier-than-air machines, and huge dirigibles a quarter of a mile or more in length, to meet the need of slower passengers.

Bright artificial lights will illuminate the tunnels, the deep basement stores and underground streets. At night the sky will be brilliant with the reflected glare from below, as well as the lights of airships and dirigibles, and the route markings and traffic signs of airways and landing stages. And advertising signs?—Well, imagine them for yourself! They may be bright enough to give everybody "klieg eyes," and end by legislating themselves out of existence!

Rare Gases Put to Work

NOW that we are well acquainted with the rare gases that appear as infinitely small parts of the air we breathe, uses for them have at last been found. When helium, and then in rapid succession argon, neon, krypton and xenon were discovered some years ago, mainly through the brilliant work of Sir William Ramsay and Lord Rayleigh, English investigators, no one knew of any practical use for them. But now we are familiar with the use of helium in airships, where its peculiar inert qualities make them noninflammable. It is practically "dead" from a chemist's standpoint; although in recent tests it was apparently combined with mercury under special laboratory conditions.

Others of this curious, inactive family of gases have now proved valuable servants of man. Neon gas glows a bright orange-red in electric vacuum tubes that serve as advertising street signs or as powerful, fog-piercing airplane beacons. Its same colored glow builds up animated pictures in the successful television process of the Bell Telephone Laboratories.

Argon-filled electric light bulbs have proved more efficient than those filled with common nitrogen gas alone. About half of the electric light bulbs manufactured today are filled with argon or other rare gases. With the exception of helium, required in larger quantities, these gases are obtained from liquid air as valuable by-products of oxygen manufacture.

Helium is extracted from natural gas; at Fort Worth, Texas, a Government plant has extracted it on a large scale for airships. Recently another use for helium has been found in the substitution of a helium-oxygen mixture for the air formerly breathed by deep-sea divers. The "synthetic air" promises to avert caisson disease or "bends," a painful and sometimes fatal malady that attacks divers who come to the surface too suddenly.

$351.00 CLEARED IN ONE DAY

So writes W. H. Adams of Ohio in August 1925. V. A. Marini of California reports **$11275** sales in 3 months. Jacob Gordon of New Jersey "**$4000** profits in 2 months." Alexander of Penna. "**$3000** profits in four months." Ira Shook **$365** sales in one day. Bram bought one outfit April 5 and 7 more by August 28. Iwata, bought one outfit and 10 more within a year. Mrs. Lane of Pittsburgh says "sold **8000** packages in one day." J. R. Bert says "only thing I ever bought that equaled advertisement." John Culp says: "**Everything going lovely.** Crispette wrappers scattered all over town. It's good old world after all." Kellog, **$700** ahead end of second week.

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Furnish secret formulas, raw material and equipment. Little capital required; no experience needed.

Build A Business of Your Own
No limit to the sale of Crispettes. Everybody likes them. It's a delicious food confection. Write for facts about a business that will make you independent. Start now, in your own town.

Profits $1000 a Month Easily Possible
Send postal for illustrated book of facts. It contains enthusiastic letters from others—shows their places of business, tells how and when to start, and all information needed. Free. Write now!

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Materials will cost only about Five Dollars. Your model, when completed, may be worth $250.

Send check, money order or dollar bill.

Book Department
POPULAR SCIENCE MONTHLY
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Getting Ahead?

Read the advertisements on Pages 150 to 182 this issue if you want to get ahead!

Here Are Correct Answers to Questions on Page 59

1. The best submarine gardens known on this continent occur at two points along the coast of California, one off Santa Catalina Island, south of Los Angeles, and the other in Carmel Bay, just south of Monterey. At either of these places a trip in a glass-bottom boat will disclose the most wonderful assemblage of brilliantly colored seaweeds, fish, and marine animals, including the famous abalone and occasionally even an octopus, or "devil-fish."

2. Like most of the other great caves in the world, it was formed by the slow dissolution of limestone by water. In this part of Kentucky the rock consists of thick beds of limestone. Surface rain water penetrated into the cracks in this rock and gradually dissolved it. In the course of hundreds of thousands of years the streams of water have hollowed out the immense caverns, of which Mammoth Cave is one.

3. In all regions that are far enough north and that are not covered with permanent ice. Such moss-covered lands are called "tundras." They exist in northern Alaska, northern Canada, parts of Greenland, and over large areas in northern Siberia.

4. Undoubtedly the Yaqui Indians, who still live in some numbers in the mountainous part of Sonora, the Mexican State just across the border from Arizona. The Yaquis have always resented control by the Mexicans or other outsiders, and have given good account of themselves many times in battles with Mexican troops.

5. If you travel through the island of Porto Rico, you will see long grayish festoons hanging like beards on telephone wires or on any other wire or rope that remains in place for several years. This moss is a variety of the Spanish moss that decorates trees in Louisiana, Florida and parts of California.

6. Balsa wood, a product of parts of Brazil along the Amazon River, as well as of other tropical regions in South and Central America.

7. Because this breed of cattle originated, so far as known, on an island named Jersey in the English Channel, off the northwest coast of France.

8. From time immemorial this has been a custom of the negroes in the southern part of the Sudan, south of Egypt.

9. This remarkable man was a real ruler and lived about 1100 years ago in the city of Bagdad, on the Tigris River, in which is now Irak.

10. This curious characteristic belongs to the Tarim River in China. The Tarim River rises in well-watered mountains and has a length of several hundred miles, over a part of which it exceeds in size many of the well-known rivers of the world. But it never reaches the sea. In the sands and salt flats of the eastern part of the Tarim Desert the river is lost by evaporation.

11. This tree recently has come into public notice through the fact that the oil it yields has been reported an effective remedy for leprosy. Government scientists of the leper station on the island of Molokai, one of the Hawaiian Islands, have had substantial success with this treatment. The chaulmoogra tree grows in many East Indian islands, but mainly in Burma, which is the easternmost part of India.

12. The largest flower known grows in the island of Sumatra, a Dutch possession in the East Indies. The botanical name of it is *amorphophallus* and it is related to the *Arum* family of plants, including the common wake-robin. The full-grown flower may be as much as eight feet tall.

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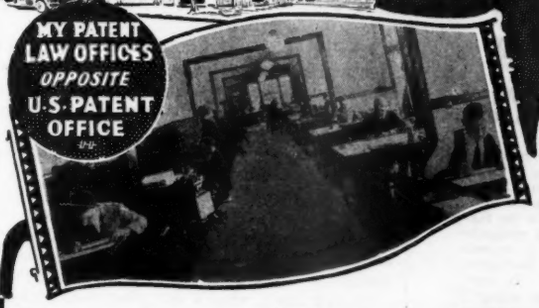

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Whirling Wheels

(Continued from page 42)

steppers out of the drive and off toward his bank; at noon, when he came home. Both times his team had shied a little, giving him the satisfaction of reining them in with capable hands; both times he had frowned at the preoccupied man who worked with it. The second time his Negro coachman had muttered; so had he. Lunch, then he had come to the library window. At first he sat in a big leather chair and stared across his broad lawns as though to blast the nuisance away by the force of his glare; then he stood, now he was pacing, back into the shadows of the long room, then up to the light of the window.

"Why doesn't he get a team and haul it away?" he snorted. "Horses; they will always go!"

BACK and forth, with every turn at the window delayed while he looked out and cursed in polite language. And that man out there worked away. At last Mr. Oliver H. Marston exploded.

"Impertinence! Using my curbstone for a workshop! I'll attend to him!"

He strode into the hall, jammed a square-topped black derby on his white hair, and with cheeks flushed, he charged down the walk, through the iron gate and up to the unsightly thing that destroyed his afternoon.

"Look here, what's delaying you with that thing?" he demanded, and the slender man looked up, smiling apologetically.

"Why, there seems to be something wrong," said he. "I'm trying to locate it."

"Wrong! Wrong! Been wrong from the start!" snapped the offended gentleman. "Why don't you get a horse and drag the thing away? I won't have it standing in front of my house a minute longer! Nuisance; menace; eyesore!"

"I'm sorry, sir; I'll hurry it off as soon as I can." The man had returned to his problem again. If the worthy Mr. Oliver H. Marston had used his eyes to better advantage, he would have noticed that for a man who was apparently in very serious trouble his hands were unusually clean; his clothes, too. But this was no promissory note to be scrutinized with a judicial eye; this was a nuisance. "Very sorry. No one is more anxious than I to be on the way."

"Well, get a team then; get a team. Haul it away from here."

"Just a minute." The voice of the intruder changed; he had hunched lower and a quick rapping sound almost drowned it out. "Ju-u-ust a minute. Think . . . fixed . . . minute."

"I HOPE so! If you had a horse you'd have been where you're going long ago. If you can't afford a team I'll get you one; I want that thing removed."

"Yes, sir. Sorry . . . Well . . . m-m-m —" lost in the rappings again. "Have it going in just a minute."

"Minute! You've been here since before breakfast! Why don't you call the factory and get help?"

"Can't. Bet . . . Race . . ." Rap! rap! rap!

"Wager? On that thing? Last thing in the world to bet on!" Still gruff, but with a vague indication of interest. If the most important banker in Detroit could have seen the twinkle in the blue-gray eyes that looked down into the bowels of the machine—but he could not. He was leaning over, though; so close that his coat was brushing the other's back. "Bet! On a thing that's been standing here for hours! . . . What's broken?"

"Nothing. Only—" The hammer rapped furiously—on a perfectly innocent floor board, it happened, though the gentleman whose curiosity was working *(Continued on page 169)*

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MAKE MORE MONEY
Read the Money Making Opportunities on pages 150 to 182 of this issue.

Whirling Wheels

(Continued from page 168)

could not know that. "Win . . . speed . . . miles an hour."

"What's that?"

The delayed one straightened up. "I had an argument with a friend this morning. It led to my betting that I could make forty-five miles an hour."

"With that?"—an incredulous snort, and for the first time the banker actually looked at the machine.

"Yes, sir. And I can't call the factory. I'm not supposed to tune up at all. Supposed to race this afternoon, but—" He rapped with more vigor than ever.

"Forty-five miles an hour! Impossible!"

"I've done it before," and he bustled around to the other side of the "thing." "Now, I think, maybe—" He lifted something on the other side with a quick motion and there was a hissing sound; he lifted again, then his arm executed a rapid whirling motion, and there was a chuff-chuff-chuff! "There! I thought I'd—" He scrambled up into the seat. "I'm very sorry, sir; I'm sure it won't happen again." One foot kicked something on the floor in front of him; he seized a handle bar arrangement.

"WHERE are you going to demonstrate this speed?"

"At the race track. I'm afraid I'm late now. I—" He did something with his right hand and the machine began to move.

"Say! Wait a minute!"

"Sorry, have to hurry." Then the driver of the runabout seemed to reconsider. He stopped and looked back with something of impatience.

"Are you going directly to the race track?" asked the outraged property owner, still brusquely.

"Yes, sir."

"Well, er—I was planning—ah—to drive out there myself this afternoon. Would—um—would you—I have a new trotter out there. Would—you—mind—taking—me—out?" He shot the last as though it were one word—and Gil Herrick, who had been angling since eight o'clock that morning for just such a bite, forgot an empty stomach and endless hours of being tremendously busy doing nothing.

"Why, I'd be very glad to, sir." Nor could he help adding, in the soberest and most deferential voice: "If you're quite sure you'd like to take the risk."

MR. Oliver H. Marston ignored that. He was already on his way back to the house. "—Get my coat," came back over his shoulder.

For the second time in six months Gil Herrick wanted to laugh. This time he had to stop it, so he climbed down hurriedly and bent his head over the runabout and grinned, widely, instead. Not that it was necessary for him to adjust anything about his machine; it was running perfectly. He had tuned it up the day before in preparation for a gambler's chance, and if his plan ended as successfully as it had begun—

It had been a long, hard six months for Gilbert W. Herrick. The marks of its beginning never left his face. Those deeply etched lines on either side of his nose had appeared there like knife cuts during the days of his flight from Boston, a blind drive from the memory of scornful blue eyes and a heavy, taunting voice. He had sought refuge in "that buggy of mine," and with it drove a reckless trip over roads that battered, through winds that froze, past teams that plunged and farmers that waved angry hands—to New York and Andrews and Morton.

"Sixty-five runabouts! Great stuff! Now you run home and

(Continued on page 170)

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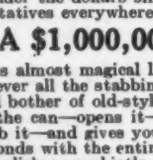

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Whirling Wheels

(*Continued from page 169*)

make 'em. We can sell 'em, all right!"

That was what those two fine men had said, knowing that the gray-faced, hollow-eyed Gil had expected to come back bringing—Some One; compelling him to take up life again by reminding him of a job that had to be done. He *had* to work; he could not quit. He had obligations. Sixty-five runabouts—from a shop where it had taken a month to finish one! And dishonesty in it!

Macintosh, the chunky Scotch foreman, heard about it first, and came as near to striking an employer as ever a man did.

"Mister Her-r-rick, I'll be takin' my time!" he sputtered when the tide of red had coursed up to his sandy hair. "Ten years I worked on the Clyde; five years in this benighted country; I've been foreman in shops where this place'd look like a tool shed, but never have I been accused o' tr-r-reachery!"

"All right," from a cold-eyed, grim-lipped employer. "Suits me. If I can't ask you who you suspect, I'll get another man."

THAT did it; the foreman calmed himself. A new boss, he had; it showed in Gil's eyes. Macintosh puffed his lips a time or two, scratched stubby fingers through hair that was threaded with white, and—"We-e-ll, I can't say that I suspect anyone," said he. "But I'll be findin' out."

And the finding out brought Wally Burns, the tow-headed machinist who had been making gas engine lore his own. "Look here, Mr. Herrick, do you think *I'm* talkin'?" His eyes were hot with injured pride. "I'm the only one besides Mac and you that's been in that room; do you think *I'm* talkin'?"

"Not now," said Gil with a tired smile. "But who is?"

He told them of Jim's brag about the four, and how he had retorted by offering Jim his drawings. He sent the drawings on, in spite of protests from both men. Then work, work, work; night and day. Another electric motor, a longer line of shafting, more machine tools, the banishment of the little lean-to and the erection of a two-room wing, for office and experiment room—how had he done it? If it hadn't been for that first laugh—

It came on a postal card, that laugh, from Italy, Florence. "Dearest Gil, I'm sorry. And I'll be coming back. Will you give me that ride?" No signature, no need for one. Just a laugh, long and loud, until the light-haired lady of uncertain age who acted as his bookkeeper and stenographer turned spectacled eyes on him—and saw him lock a picture post card in his private drawer. Then work with a new vigor, to see a row of lathes and milling machines and drill presses line themselves along one side of the shop, five trestles fill the aisleway on the other. Runabouts taking shape, disappearing into freight cars after a test by Wally, and being replaced by others. Money coming in—and going out faster.

MONEY— His slender deposits were increased by partial payment checks that accompanied the first orders, for thirteen runabouts in all. He had shipped two during the first month that followed, and added the sight drafts that he attached to their bills of lading. That had helped on the first purchase of secondhand machine tools, but — buying bodies, transmissions, wheels, tires and motor parts, and meeting a steadily growing pay roll —the ancient problem of working capital was staring him in the face.

Then Jim had come to town. "To sue you on the Selden Patents? Haw-haw! You? We're after big bugs like Winton; they *sell* runabouts. Your buggy ain't sellin' an' you know it!"

"Sold one to you, all right! You can't even send a friend to buy (*Continued on page 171*)

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Whirling Wheels

(Continued from page 170)

ll for you without Andrews and Morton writing me about it. Going to imitate it?"

"Right you are—in a factory right next door. Unless you want to sell me this place."

"Not for sale. But I'll sell you one of the lots next door—for a million dollars a foot. They're mine, Jim; I had a hunch you'd be coming."

"Bright boy! Well, much obliged for the drawings, anyhow. I thought you was bluffin' when you said you'd send 'em; that's what I was doin'."

Then Gil had summoned Mac and Wally. "Here's the—gentleman," he informed them, "who tricked me out of the four. There is no leak in my shop, thank God; it's only this—. His name is Wenden, boys, and he'll be looking for the best men I've got to come to work for him. Here they are, Jim; the two best men I've got. Maybe you'd like to dicker now."

But Jim had had letters from New York, from bankers of no little weight; Jim had told him so before he had stormed away from three men who jeered at him; and when Gil went in search of loans the few men who permitted him to ask them were "very sorry indeed. Highly speculative this automobile business. Ever heard what Oliver H. Marston thinks of them? Luxuries, uncertain of demand, with many fly-by-night manufacturers of no reputation making them." (Thanks, Jim.) "Glad to have your account if you care to bank with us, but—" and the Herrick Automobile Company, newly incorporated and with most of its stock still unsold, was staggering for a fall.

MR. Oliver H. Marston had been the one they all quoted. President—and everything else—of the Founders and Merchants National Bank, the Gibraltar of Detroit. No need to suggest to him the undesirability of horseless carriages; he already had his sentiments about the noisome things that popped along the streets and frightened his sleek horses.

"I'll tackle him," Gil had said with a battle light in his blue-gray eyes.

"You'll tackle a terror," had been the reply of young Robert Legg, the keen-faced, dark-eyed attorney who had handled his incorporation. "He's harder to crack than any other man in town. Likes his notes gilt-edged and his horses blooded."

"And therein lies a thought. He won't listen to back-biting, and if I can nudge him on his bump of curiosity—. Ever see animals in a field look up to watch a strange thing move? If I can get him into a runabout once—"

SO HERE was Mr. Oliver H. Marston, hustling back to the curb, where a motor idled sweetly at the behest of the fingers that had made it, while a wiry, dark-haired young man waited—Gil hoped—at the Fair Grounds, ready to play the part of a Doubting Thomas.

"All ready." The runabout sagged a little beneath the weight of a curtly speaking banker. "Know where it is?"

"Yes, sir; straight out Jefferson. What time is it, please?"

"Three-fifteen. When is your engagement?" They were rolling along smoothly.

"Three-thirty. And I did want to run up to the plant for a minute. Men are working overtime today."

"You'll never make it even if you go straight. Takes me half an hour with my best horse."

"Well, we'll try," and the speed mounted a little.

"Call that trying?" Mr. Oliver H. Marston was leaning forward.

"It's the best I can do. The speed limit is eight miles an hour in the city."

Then the banker took his eyes away from the road and the

(Continued on page 172)

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Whirling Wheels

(*Continued from page 171*)

traffic ahead and looked out behind. "Go on, let 'em out," he commanded, as though "they" were horses. "No bicycle policeman in sight."

"Risky," Gil worried, "but—" The trees that bordered the boulevard width of street began to pass them more rapidly.

Even so, they were behind time at the Fair Grounds, but Gil remembered to be a good host. "Now, if you'll tell me where your stable is—"

"Never mind that! I want to watch this thing race."

Bob Legg was there, pacing back and forth. "Late, of course!" he jeered. "Another one o' those breakdowns!" and banker Marston had found a kindred spirit.

"Breakdown? I should say. Been all day in front of my house," said he. "Forty-five miles an hour! Why, he didn't go at a trot coming out here!"

And Gil looked quite resigned. "Perhaps," said he, "we can do a little better on the track. Shall we try? And would you mind acting as judge? You are so unbiased, Mr. ——" he hesitated.

"MARSTON; Oliver H. Marston," and he produced a handsome gold stop watch. "Standing start or flying?"

"Let's give him all the help we can," said Bob Legg tolerantly. "Make it a flying start; best time out of three heats."

Speed, on a circular track without banks! Stakes? Gil trembled when he thought of them. He ran down the track, turned, and came whizzing back. An airy gesture at the two men and he was gone in a cloud of dust. The first turn. He swung wide, his rear wheels skidding, and cut across. Zip! the white-washed fence was close, then gone; he was on the backstretch. Another turn. He was coming in, both hands gripping the steering bar, his engine racing wide open.

"Two minutes," from a hugely satisfied judge. "That's only thirty."

The second heat was better; 1:55; then Gil shook his head doubtfully. "I'm afraid I can't make it. I didn't calculate on the turns. I should have some extra weight on the inside to hold the wheels down. Then I could cut my curves shorter." He looked speculatively at a number of stable men and boys who had gathered at the rail. "Would one of you like to make some—"

"Never mind." It was Mr. Oliver H. Marston himself! Stung by the god of speed! "I'll go."

BUT Gil Herrick shook his head. "No, sir! It's too dangerous. I want a man to hold the inside wheels down—and take any spills that come; I don't—"

"Bosh! I've driven this track many a time; I know what you want. Get ready!"

Down for a turn, then back again. Zip, whoosh! A turn. Whee! The straightaway, with a white-haired man yelling like a Comanche Indian. "Give 'er the whip! Let 'er out! Close to the rail! Yow!"

This time it was 1:48—less than forty-five miles an hour but "faster than any trotter I ever drove!" And Jim Wendon had said Gil was done!

Three men piled into a runabout for two after that, one of them completely forgetting the fact that he had come out to see a trotter. Nor was he reminded of it.

"Would you mind if I stopped at the plant a minute on the way back?" asked Gil. "There's something I'd like to—"

"Not at all; not at all. Fact, I'm curious to see your place. I have a confession to make, Mr.——Herrick, is it?" said a bright-eyed old gentleman with dust in his white hair. "I've had a very great

(*Continued on page 173*)

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Whirling Wheels

(*Continued from page 172*)

prejudice against these things. Very great. But—how is your plant running?"

It was busy, that shop; Gil had seen to that. Every man was working on this Saturday afternoon. The row of machine tools along one side, the aisleway on the other, the frames of runabouts in assembly, men leaning over machines, moving between the workbenches and the trestles. Gears hummed, pulleys squeaked, hammers clinked, and through all the noises came the steady "-ing-g-ggg!" of a gas engine exhausting at high speed. The pungent odor of hot cutting lubricant filled the air, the floor beneath their feet pulsed with the vibrant life of a producing organization. Mac busily directing, Wally in the yard tuning up a motor—Gil's shop, achieved at the cost of night and day thought and work!

"Want to see my new engine? Twice as powerful as this one."

Two cylinders opposed, the engine that made that sound; bolted firmly to stanchions in the room that could be entered only through the office. "That's turning up close to six hundred. Put your hand on one of the cylinders. They're water cooled, so they won't be hot. Steady, isn't it? I tried running it without anchors the other day, and it hardly moved. Vibrationless. Make a great automobile for next year."

Then they prepared to drive him home. Mr. Oliver H. Marston had climbed into the runabout and Gil was cranking up, when he looked down with white brows drawn into an ominous frown.

"Look here, young man; there's a nigger in this woodpile. Just how badly out of order was this machine today?"

Gil spun the crank and the motor chuffed smoothly; he climbed into his seat and took the steering bar, and they rolled out through the gate. Then, as they turned down an unpaved street in the direction of the banker's mansion, he turned twinkling eyes upon his guest and made a true confession.

"It wasn't broken at all," said he.

"H-m-m! . . . Is that thing hard to steer?"

"Oh, no, not at all. Here, take it a minute. Left hand, but it's just as easy." They rolled along for another block, the banker's eyes bent upon the road. "There's a little knack about avoiding the ruts—get it?"

"Yes. Seems to do quite well. Al nost forty-five miles an hour . . .Hm-m-m! . . . Just how much is it you want to borrow?"

DONE? Suppose the shop did have to close down tight before the year was over; suppose stock was going begging. When Mr. Oliver H. Marston accepted a note and relieved the cry for working capital; when after Gil had taken it up promptly on its due date and that gentleman went so far as to buy some stock—"say, ten shares on a gamble; maybe there's something in these infernal things"—and accepted a seat on the board of directors—"to see that you don't try any more of your tricks on me, young man—" did that look like done?

Just the same, it was not pleasant to close down the shop. But there was nothing else to do, both that year and the next. Andrews and Morton had reduced their orders to thirty; Tinsley had cut his to ten. Those, with six more than had been ordered by mail during the early summer, were all shipped out by the end of August, and there were parts for four more machines on hand. No, the shop must be closed down. But even that brought its compensation.

"Mister Herrick, I'll be takin' no lay-off."

"But Mac, I——"

"Part time, maybe; I can stand that. But—I been thinkin'. That Jim Wenden an' all. There's somethin' about this business." He stopped and looked

(*Continued on page 174*)

Strengthen Your Will

by Simple Exercises!

By B. C. McCulloch
President, The Pelman Institute of America

OCCASIONALLY there have been times when momentous decisions had to be made—decisions that affected the entire course of your career. How often have these occasions found you vacillating and indecisive. You couldn't "make up your mind." So you wavered, helplessly, until usually some other person, or some circumstance, *decided the matter for you.*

No—it surely needs no argument to convince you that a *strengthened will-power* would completely alter the circumstances of your life—and inevitably for good!

But *can* you strengthen your will-power? There is no question about it! Will-power is a faculty of the human mind, *and it can be trained like any other faculty.* In fact, it is very *quickly* susceptible to training.

The truth is that indecision—weakness of will—is due to a very obvious condition. Those who suffer from it *seldom use their will-power.* From childhood on they have let others do their deciding for them. This fine quality, the backbone of character, has been thoughtlessly trained *out* of them, instead of *in* them. There is only one way to strengthen your will-power, it is—*to use it!*

If your legs were kept in splints for a year, and the splints were then removed and you were placed upon your feet, you would sink to the ground under your own weight. Those particular muscles, *unused for so long,* would be unable to hold you erect.

There is positively no difference—in principle—between your muscles and your will, or any other mental faculty. Your will-power, just like your muscles, becomes *strong* with use,—and flabby, weak and atrophied through disuse. *Learn to use your Will, then,* if you wish to strengthen your will-power, if you wish to realise the possibilities that you feel and know are within you.

The way to do this is through "mental exercise," just as the way to train your muscles is through physical exercise. This simple and sane point of view is the basis of the movement known as Pelmanism.

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Whirling Wheels

(*Continued from page 173*)

about the silent shop. "I'm thinkin' it's goin' to go. I'd—I'm wantin' to buy a leetle stock. Say, fifteen shares?"

"Why, Mac, it's——"

"Now don't be turnin' me down," growled Mac. "This is not sudden, this; I been thinkin'. An' ye can give me half-time, too; I know it's tough right now. But—I'll be wantin' to stay an' keep me eye on that stock."

"An' that goes for me, too," from Wally Burns, the tow-head. "I can't buy no stock, but I can work for—well, not nothin' exactly, except when I'm out on the road. But I can take a darn sight less pay than this old Scotchman here. He's got a family; I'm loose. We gotta beat that Wenden, that's all."

"Boys, shake hands; we'll do it! And now—the nineteen-two model. Two of 'em, the finest ever made. One for Mr. Oliver H. Marston."

"Gee whiz!" gasped Wally Burns. "The old boy's bit!"

IT WAS perfect, that 1902 model. It was built along Gil's ideas, improved by suggestions from Wally. For Wally had become a trouble man, and many times that summer had gone out to succor the pioneer drivers of Herrick runabouts. It was money well spent, for out of his travels came this: No matter how smoothly a machine may run in the hands of a factory man, it will develop "bugs" in the hands of an owner. A mechanic nurses his machine instinctively, the average owner does not. All he wants is something that will run with the least amount of trouble. Hence—

The new, double opposed engine was mounted exactly as before—beneath the seat, but it was equipped with a mechanical oiler instead of the oil cups that needed frequent turning up. The oiler was a box-like affair set over the crank case and driven by a belt from the crankshaft, forcing oil in regulated drops through copper tubes to the bearings. A handhole was arranged on either side of the crank case, through which the main bearings could be changed in emergency. The same two-speed planetary transmission was used, and the power was carried back to the axles with the same kind of chain, but there was a spur gear differential instead of a friction one, and new bearings, made and sold by a man named Timken who had called several times that summer, replaced the former balls.

A STEERING wheel was installed in place of the bar, and it was so arranged that it could be tilted forward when the driver entered his seat, on the right hand side. The greatest improvement of all was the carburetor. Instead of being a plain mixing valve, with an elaborate ball-check suction system for the feed, this had a float in a chamber and a movable needle valve. The engine speed could thus be regulated with a throttle instead of a spark lever. The water cooling pipes were moved forward, summer driving having shown that insufficient cooling resulted when they were under the floor boards. They now hung below the forward end of the dashboard, and the coils were covered with fins, the better to radiate the heat from the water. And, being heavier, a frame of bicycle tubing was constructed.

This was the machine that maintained through two years, except for a change in the location of the engine. For the 1903 model the double opposed engine was moved forward and placed under a hood, which permitted the gas and water tanks to be built under the seat. For it takes money to change a model, and the 1902 machine failed to move, too. Gil predicted it at the 1902 show.

He was standing on the balcony of the Madison Square Garden (*Continued on page 175*)

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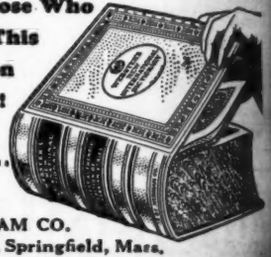

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Whirling Wheels

(Continued from page 174)

looking over the exhibits and the crowd, and Andrews and Morton were standing beside him. The crowd was indifferent, casual. And Gil, who never came to New York that he did not halfway expect Gail to come walking down the aisle, turned his thoughts away from her long enough to give his impression.

"Look at 'em," said he. "Walking around—looking. Like sightseers at a museum."

"By golly, you're right!" exclaimed Andrews softly. "Lookers! 'Pretty things, aren't they? So shiny and nice. Let's look at this one.' They certainly aren't here to buy."

That in the face of a Reliability Run, finished two months before, with eighty machines, fifty-four gas and the rest steam, starting away from Fifty-Ninth Street and Fifth Avenue and nearly every one of them going the whole route; from New York to Buffalo in six stages of seventy miles each. It was no race; it was a great demonstration parade, with a Herrick and a Wenden among them. Fifteen miles an hour average speed the maximum, eight miles in cities, in order to keep down the sentiment against "scorchers." Over terrible roads—Gil knew them well!—through rain and mud that splashed up and short-circuited many an ignition system, across loose bridges; but they nearly all finished.

And people watched that parade; thousands of them. They had made a holiday of the event, lining the roads to watch, and even serving refreshments free of charge to the drivers. They watched the changing of tires—tires were the biggest trouble those runners had. They pulled unfortunates out of ditches or up the grades too stiff for some to negotiate. They cheered the first ones into the controls each night. Now this!

"Well, maybe they're lookers," said Morton. He was less given to heights and depths than Andrews. "Maybe so, but we'll gamble on finding fifty next year who'll do something besides look. And next year—"

Next year. Oh, that was a show, that one of January, 1903! No indifference there; none of that low-voiced business; no museum aspect. The public had waked up. Buzz, buzz, buzz, until you couldn't hear yourself think. Crowds, jamming the aisles, jostling the exhibits, hounding the exhibitors. Poor exhibitors! Answering questions all day long, hurrying up and down the aisles with blue shadows beneath eyes that glistened. Talk, talk, talk, all day long; talk, talk, talk, all night. Production, sales, contracts, deliveries. The age of motors had dawned: the automobile had arrived!

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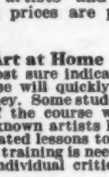

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Treasures That Fall from the Sky

(*Continued from page 28*)

that led Henri Moissan, the French scientist, to try to reproduce experimentally the conditions which apparently formed them, and thereby produced the first man-made diamonds."

Meteorites have always been known to vary greatly in size. Some are no bigger than a pea, others weigh many tons. For a long time, the largest meteorite known has been that which Admiral Peary brought from the shores of Melville Bay, near Cape York, Greenland. There were three meteorites in that find, all known to the local Eskimos and called by them, picturesquely, the Dog, the Woman, and the Tent.

The smallest of these, the Dog, weighed half a ton; the largest, the Tent, 36½ tons. The story of how that unmanageable mass was transferred to the deck of Peary's vessel, mainly by leverage, gravity, and will power, and with the simplest mechanical equipment, in a race against time (since at any moment the ice might close in and prevent the ship's escape until the following year)—that is one of the romantic chapters in Arctic adventure as well as in the history of meteorites.

BUT all previous ideas as to how big meteorites ought to be are rapidly fading in view of the researches at Meteor Crater and another great discovery in the desert of Adrar, near Chinguetti, in Mauretania, French West Africa. A mass found here is described by Antoine Lacroix, of the Academy of Sciences of Paris, as lying in a lonely spot among the dunes, covered by a desert plant called *sba*, and roughly 100 meters long by 40 meters high. Analysis in Paris of specimens chipped off indicate that it is truly a meteorite.

"If," Lacroix points out, "the dimensions are correct, and there is no reason to doubt them, this block of metal is by far the largest known meteorite."

He estimates its volume to be not less than 160,000 cubic meters. An enormous bulk! It is easy to imagine what would happen if anything like *that* dropped on, say, the White House lawn.

I asked Dr. Farrington about the menace of meteorites.

"Strangely enough," he replied, "so far as is surely known, nobody ever has been killed or hit by a falling meteorite. But there have been narrow escapes.

"A MAN near Farmington, Kansas, was lying under his wagon, repairing it, when a meteorite weighing more than a hundred pounds plunged into the ground so close to the wagon that he was splattered with dirt.

"In Michigan, a farmer was plowing when a shower of meteoric rocks began falling around him. He is said to have rushed to town for the sheriff, believing that enemies hidden in the woods were pelting him!

"A meteorite near Shelburne, Ontario, fell between the porch of a farmhouse and an outbuilding, passing within eighteen inches of the porch, and splashing mud over windows and walls. John Shields, the farmer, was in the house with his family. Had there been a rod's difference, the meteorite would have struck the house squarely, and somebody might have been killed.

"Three children had a close call at Braunau, Bohemia, in the year 1847. An iron meteorite weighing about 40 pounds crashed through the roof and ceiling of the room in which they were sleeping. Debris fell on them, but they were not injured.

"From such instances, you can see that it is quite possible to be hit by a meteorite. Sometime, I believe, it will happen."

It is a popular notion that meteorites come to us intensely hot. This is seldom, if ever, true. The Colby, Wisconsin, meteorite, which panic attributed to German long-range gu is a case in point.

The villagers gathered to exhume it after it fell. The day had been hot. sooner did the stone reach the surface and warm air than it turned snow-white. Ginger men touched it. To their amazement, it cold—colder than blue ice—*so cold that a man could hardly bear the feel of it on his naked flesh!*

SIMILARLY, a meteorite which fell at Dhurmsala, India, was so cold that people who touched it soon after it fell, fairly "burned" their hands with frost bite.

"The fact is," said Dr. Farrington, "most meteorites, probably all, come to us with the cold of outer space. Considerable heat is generated on the surface by atmospheric friction, and if the conductivity of the materials is high, the entire meteorite may become quite warm. But meteorites attain a velocity of anywhere from eight to forty-five miles a second, and are in our atmosphere only a few seconds, so usually the heat is on the surface.

"I picked up a stone that fell in the shower at Modoc, Kansas, before anybody else saw it, and while the 'clues' were undisturbed I could see where the stone first hit, then bounded before coming to rest. The grass was tinder-dry. A spark would have ignited it. But it was not burned, nor even singed.

"Meteorites have fallen in haystacks and in barns full of inflammable materials. But there is no instance of fires so caused.

"I visited John Shields of Shelburne, about after the fall of the meteorite that missed his house by inches, and he mentioned a curious fact. A burdock plant was in the way, and the meteorite pushed a burdock leaf ahead of it into the ground. The leaf was found sixteen inches underground, pressed against the lower face of the meteorite. It was not even singed.

Curiously, there is no one part of the earth's surface to which meteorites seem specially attracted. They are found all over, and in the most diverse settings. One of the picturesque Gay Gulch and Skookum pair, found by miners in the Klondike, was imbedded in Pliocene strata millions of years old; another was found in Adelie Land by the Australian Antarctic Expedition *on top of the snow*. Peary's York Point iron came from within fifteen degrees of the North Pole; and one of the rarest varieties known came from a Brazilian jungle almost under the Equator.

Usually they are picked up by chance, unless seen to fall; and in this country, at least, they belong to the land where they fall.

"Certain meteorites," said Dr. Farrington, "are valued far higher than others, owing to peculiarities in composition. Thus, pieces from a small meteorite found in Brazil have brought as high as seven dollars a gram: more than the price of platinum, and probably the highest price on record."

SO, TO return in closing to the significant breaking of a drill at Meteor Crater, if that incident means what it is believed to mean, one of these days, soon, an extra chapter will have to be written in the history of meteorites and in the hazards of life. Scientists declare that the Coon Butte meteor, if it really exists, is probably 500 feet in diameter. That is nearly twice the size of the great Chinguetti iron in the desert of Adrar, and its fall could wreak twice the damage.

Others, unknown or unrecognized, may have fallen elsewhere. And—though it is not a cause for losing sleep—it is not at all impossible that the world's next great catastrophe may spring from collision with a meteorite rivalling or out-measuring these.

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Burglar-Proof Home Easily Possible

(*Continued from page 68*)

stantial garage lock very effective for two-leaf hinged doors is of cylinder type with a revolving rod that throws bolts into floor, ceiling or lintel and also at the center. Where garage doors are automatically operated by an electric motor, no lock is required. The mechanism itself prevents the doors from opening when a switch is turned within the house. Some ingenious homemade devices have been worked out to safeguard garages, especially when the latter are adjacent or built into a dwelling. Interior garage bolts or rods may be controlled from the inside of the house. One amateur invented a lock consisting of an inner metal bar pivoted at one end. The bar was held nearly vertical to the door edge by a removable loose nail of which the head, showing outside, had a normal appearance. Removing this nail dropped the bar crosswise, which secured the door. Here the bar rested on another loose nail, which being taken out caused the bar to fall parallel to the door edge, thus permitting the door to be opened.

THE fewer outsiders or strangers enter a house the better for its safety. Pretended messengers, icemen, meter men and telephone men commit immediate theft or plan a future raid. The outside filler for an ice chest, if not an automatic refrigerator, has varied merit beyond eliminating the liability of the human factor. An electric meter can be installed outside the house. There is scope here for an optical device whereby such meters, located in the cellar, may be read from the outside.

The prudent person never leaves jewelry or money lying about or placed in a drawer within sight of visitors.

It is a common and hazardous American custom to leave most of the window shades up at night, whereby anyone outside can see about everything inside. Thus the crook studies the plan of the house, locates valuables and sizes up the occupants. If the shades are down, he does not know the house layout and is deterred by his ignorance of the number and quality of persons within. A mere light in a shaded house will keep most intruders away. The shades should be opaque, otherwise the outside watcher obtains an excellent summary of the occupants by their silhouettes.

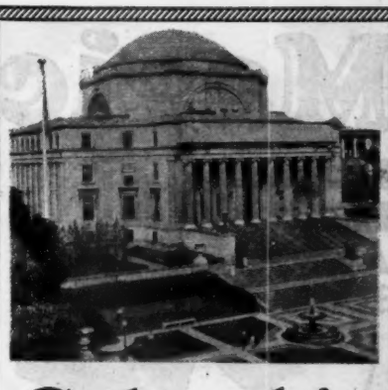
A SMALL snappish house dog of a nervous temperament is often a better guardian than a large dog who is kept outside and is subject to poison or insidious cajolery through a mate.

"I keep a terrier downstairs to give warning and a bulldog upstairs to take hold," said a householder of experience.

Shall we shoot the burglar? "Don't," is the advice of experts, on the ground that the average citizen with a revolver is lucky if he can hit any part of a human outline at a distance of twenty feet. If we shoot, he shoots, and probably with damaging consequences. Let him take his loot and go in peace. A revolver is more of a menace than a defense to the average home owner and has caused many sad accidents.

If this doctrine of nonresistance seems to be common-sense, it may yet be questioned from the standpoint of national morale or morality. Doubtless it has been promoted by burglary insurance. It would have shocked our hardy ancestors, who were used to defending their homes and themselves against all comers. The argument that it does not pay to fight has been accepted even by paid armed guards, and is often demonstrated by the neutrality of hundreds of citizens who witness the work of a single robber.

Make your house difficult to enter and probably you will not have to solve the problem of safety versus the duty of a citizen.



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Address.....

.....*Age*.....

They're Creating a New World

(Continued from page 35)

X-ray, for the copper industry with electrolizing processes, for the oil industry in saving the by-products, for the lumber industry in snatching alcohol, silk stockings, ammunition, paper, and paint from our trees; and in solving the problems of saving rubber to make cheaper automobile tires. There are fairy tales in coal tar dyes, in "corn products."

THERE are far-reaching political and social effects of present-day chemistry. The patient investigators of one country create possibilities in the way of economic raw materials which urge their government to new relationships with foreign countries. Some new comfort or utility may change the social aspect of an entire people.

Only yesterday—as time goes—the wood distillation industry—in which is bound up, in the United States alone, more than $100,000,000—has been dealt a body blow—by a new synthetic alcohol called methanol. The old-time varnish business is feeling the hand of a new competitor, a compound of cellulose in solvents, which has risen in the last couple of years to the point where it plays on the stock market.

Paint makers are interested in a synthetic resin. New rust-resisting metals are in the market. Thanks to the agricultural chemist, the grape growers are now able to make a syrup out of scrap raisins and stems.

An English chemist has been able to get glucose from formaldehyde with the ultra-violet ray. The artificial silk, or rayon, business is growing amazingly.

Aviation calls for the chemist's work in dealing with hydrogen gas, with anti-knock motor fuels, and with various kinds of so-called "dopes."

What we can do today with Portland cement in building construction and in engineering is the result of thousands of years of research and experimentation. We even have a hydraulic cement that "sets" under water.

Coal tar continues to furnish all of the romance of the chemical rainbow, and many new colors, tints and shades are finding their way into industry. The making of modern explosives is essentially a chemical industry, and we would probably never have had any matches, had it not been for the chemist's experiments in research of other things. Casein, from skimmed milk, is made into paint, glue and other commodities by the industrial chemist, who also extracts from the waste of the slaughterhouses and the fish wharves for the baser glues and gelatines.

THE industrial chemist is enabling us to refrigerate, as scientifically as we have roasted and boiled. He is protecting our water supply from pollution, so that within the last decade the death rate from typhoid in the United States has been reduced by more than seventy per cent.

The modern chemist tells us all about the compounds of elements in plant foods, and how, when the soil has been exhausted by too continuous planting of one crop, it can be recharged, fertilizers supplying the missing chemical elements. We draw nitrogen from the air, phosphorus from other soil, and potassium, calcium, iron and sulphur from mineral compounds.

After our grain foods, we eat chiefly carbohydrates: that is, sugar, starch, and cellulose, and the number of different substances which eventually yield these carbohydrates is amazing. With the help of the chemist, we are continually getting sugar from new sources, one of the latest being ordinary wood sawdust. We could not long survive without certain fermentations. We need them in our milk, our vinegar, even our bread.

Chemists discovered that we need in food certain important chemical substances, including a new one, since known as vitamins.

When it comes to animal flesh as a food, even this goes back to agriculture as its basis. Then we have the problem not only of the animal food itself but of the by-products, which we get from the stockyards. Here the chemist does some really remarkable things. We use not only the meat, but the skin of the animal, his hair and bristles, his horn and hoof, his bones and sinews, even his blood. Many pharmaceutical preparations are fabricated out of his glands.

Not only is chemistry used in building up foods, but it is most important in detecting frauds and adulterations. We are protected by pure food and drug laws and the chemist is our watchdog.

Very often, nowadays, when the industrial chemist (or the physician for that matter) finds himself faced by an unusually puzzling problem, he is apt to say to himself "Let's get a bug to help us."

THERE is a bug ready and able to help us in most of our problems. Bacillus, bacterium, germ—whatever we may call him—the bug that works chemical changes may be very useful to us if we really know how to command his services. The industrial chemist has made this his business. If the activities of a particular bug are sometimes tearing down a substance, they are often a useful preliminary to building up another which is beneficent.

The other day I said to a manufacturer of a new varnish, "Were you not left by the war with a big acetone plant on your hands, with no market?"

"Yes," he said, "I did not know what to do with it until a young chemist showed me how to use the bacillus which turns corn into butyl alcohol. While the war was on, the armies needed vast amounts of acetone for making explosives. We reclaimed from the ocean vast quantities of kelp, from which we extracted acetone. Later, we made it from corn, splitting up the corn spirit into a great deal of butyl alcohol and a small quantity of acetone. The latter we used and the former we threw away. Then came peace, and nobody wanted acetone in such large quantities.

"But a great deal of capital had been invested in plants for making acetone. What to do with these plants was a poser. Then a chemist suggested that we turn about, throw away the acetone and use the butyl alcohol. The latter dries in a lacquer more slowly than the former, but just as satisfactorily, in the end, if not more so. So we readjusted our ideas."

It was not until quite modern times that boat builders and those responsible for docks and wharves began to use certain paints or varnishes to keep off marine borers, such as barnacles and the teredo. Nowadays, practically everything has a protective coat to "save the surface."

DURING the last few years, great strides have been made by the chemists in producing quick drying coats for varnishes and lacquers. The automobile and airplane industries have stimulated this. In fact, when the history of the Great War is written, and the full credit given to industry, it will be only just to say that the Allies were greatly aided in winning the war by paint and varnish. Machinery was preserved, airplanes and dirigible balloons made possible, and ammunition, from small cartridges to high explosive shells, greatly improved in efficiency.

And so it goes—no end to the unfolding panorama of what the chemist is doing to make life easier, freer, more comfortable.

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What Lindbergh Found in His Mail Bag

(*Continued from page 19*)

pencil than ink; more from small towns than from cities or country. More came from women than from men. Nearly as many came from youths as from adults. Girls wrote more than boys in ratio of about four to one. Most writers put in their addresses; many, their photographs.

One person out of five sent some sort of newspaper clipping. Nearly one letter in twenty contained a poem about Lindbergh or dedicated to him. More than 5,000 Lindbergh poems were written in all. About $10,000 of return postage was received, and there was also some cash. More than 400 Lindberghs had written to Slim by the time he reached New York, claiming close relationship and asking if he couldn't do something for them now that he was the outstanding member of the family.

Next in number to the appeals for help came the business offers. I doubt if Lindbergh will ever know the extent of the promised fortunes of those offers. A conservative estimate by a well-known banker is $6,000,000.

MORE than half this amount was covered in perfectly feasible moving picture contracts. One company offered him about $500,000 if he would put in a few days doing the star part in a picture that would represent American home life. Another wanted him to do an air thriller in twelve releases at $40,000 a release. Still another offered him $100,000 to appear in a film in which he would actually be married, the stipulation being that there be close-ups of his face when he first met the girl that appealed to him, and at the moment he was pronounced her husband. For this unique pictorial study of emotion it was said he would receive $1,000,000.

The most amazing offer he received in Europe was of $2,500,000 for a flight alone around the world. Perhaps the easiest money he could have made was a proposition which involved about forty minutes of his time. He was to get $240,000 if he would stand in front of a camera which registered both voice and picture and read his own first account of the flight across the Atlantic as published in the press. He could have made about $300,000 by letting a talking machine concern make a record of his story in his own voice, the reading to be bracketed by the Marseillaise and the Star Spangled Banner played by a big orchestra.

LINDBERGH knew of most of these enticing offers, but in every case he declined them graciously but firmly. He seemed determined not only to devote himself to his chosen calling of aviation, but jealously to guard against the danger of cheapening either himself or the achievement for which the world had honored him.

In his mail were countless smaller offers of which he never knew. Typical among them was an invitation to become a partner in the operation of a chain of small stores. As a special inducement the man who made the offer agreed to let Lindbergh use his name on the store windows! "You will find me a good fellow to deal with," the man wrote as an added attraction, "I don't get angry very often, and when I do I usually go away, so will not fight."

Next in order of their numbers came "mash notes." These were to be expected. Lindbergh is young, and famous, and good looking. He doesn't drink nor smoke nor dissipate. He is full of health. Though he resisted all business offers save his book and his story in the newspapers just after his arrival in Paris, this money with the $25,000 Orteig prize which he won, has given him a comfortable fortune.

Many has been the match made by a chance letter. Youth is full of romance. Why shouldn't the girls have written (*Continued on page 180*)

Dear Mr. Dobe:—

"I've been averaging *better* than $1,000 monthly the past 6 months. There will also be profits from my patent that your individual training enabled me to create and design. Engineers estimate this patent to be worth $500,000. I owe all this to your instruction and the fine advice and help you have given me."

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What Lindbergh Found in His Mail Bag

(*Continued from page 179*)

Charlie how they felt? Most of us who had a chance to read the letters were impressed by their sincerity and decency. There wasn't the cheapness about them that one might expect in the circumstances.

"I like your looks and believe you would like me"—"We might hit it off; who can tell?"—"I believe if you and I came to like one another we might be just suited"—"Excuse me for writing, and I shall expect to hear from you when you reach town." Frank and straightforward were most of the messages, written by wholesome girls to a wholesome young man.

HOW did Slim feel about them? How does he regard the flood of love notes and proposals of marriage? Well, he never has said. Whenever the letters have been mentioned, he always has smiled his famous smile—and changed the subject. I fear, though, that the thousands of lovely young women—and elderly ones, too—who lost their hearts to him, remain among the vast throng of unanswered admirers.

Of all the letters, however, the most interesting to me—and I know they would have appealed to Lindbergh—were the ones that told about new inventions. True, many of them made wild claims that never could be substantiated; many were from obvious cranks; and many talked more about the millions of dollars promised in quick profits than about the practicability of the article. But the majority of them were of real and specific interest, and showed promise in those who wrote them.

I think these inventions thrilled many of us who were working on the Lindbergh mail, because they indicated what terrific and country-wide energy is daily devoted to mechanical development. If only one thousandth of the inventions proposed to Lindbergh ultimately turn out to be useful, transportation, communication, industry and hygiene in America will be revolutionized in the next five years!

Prominent among the creations which inventors described to Slim applied to aviation. Hundreds of young men proposed devices for stabilizing an airplane so that it could not upset in flight. Most of them had developed some new form of wing or automatic control to make an accident almost impossible. Surely this shows how intense is the effort to bring about safe flying. Many sketches for new kinds of parachutes were submitted; parachutes for the plane as well as for pilot and passengers.

ONE mechanical genius wrote: "When you come to my town I want to show you an engine I have built that will run for twenty-four hours on a gallon of fuel, and run strongly enough to pull your *Spirit of St. Louis* at twice the speed you made across the Atlantic." He only hinted at the chemistry of his marvelous fuel and the mechanics of his super-engine.

Then there were inventions that had nothing remotely to do with Lindbergh or aviation. The fact that the flyer had been so resourceful and successful seemed to indicate that his genius might be applied in almost any line. Slim is scarcely a horseman, yet a retired mariner wrote asking him to join forces in a device to prevent horses from running away by the simple method of fixing a boat davit to the car or carriage, by means of which the runaway animal could be hoisted off the ground during the period of his frenzy!

Innumerable letters contained proposals for improving radio. Chief among these were ideas for television, distant radio control, power transmission by radio, and airship guidance with radio waves.

A large number contained requests for aid in perfecting "sure fire" perpetual motion machines.

A college professor (*Continued on page 181*)

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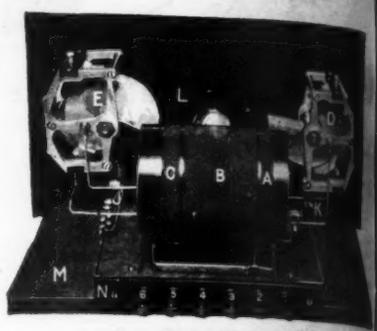
POPULAR SCIENCE MONTHLY publishes reliable blueprints of radio sets. These sets give excellent results and can be made by anyone who is handy with tools.



One Tube Radio Set
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Describes a simple, one-tube regenerative receiver of the fixed coil type. The regeneration is controlled by a variable condenser and does not affect the wavelength adjustment. Quality of reproduction is excellent because no audio frequency current flows through the tickler coil. The coil is hand wound and the rest of the parts can be of any standard make.

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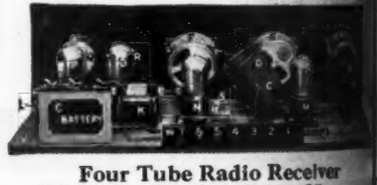

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Describes a four-tube radio receiver consisting of one stage of radio frequency amplification, a regenerative detector, and two stages of transformer coupled audio amplification. It gives the greatest power for distance and volume that is obtainable from four tubes. Easy to build, uses all standard parts except the coils, which are simple to wind by hand. Two control tuning and regeneration does not affect wavelength adjustment.

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—will start you on the road to success. See Money Making Opportunities on pages 150 to 182.

What Lindbergh Found in His Mail Bag

(*Continued from page 180*)

wrote that he thought Lindbergh might be interested in helping him perfect a gun which would sink any battleship in the world with one shot.

I read at least three proposals that Lindbergh join in an attempt to reach the moon by a rocket shot from the earth. There was one plan to communicate with Mars. Other plans outlined to the flyer were for making gold from sea water and diamonds from carbon, and for finding buried treasure.

A "biologist" very seriously solicited Lindbergh's interest in a scheme for grafting wings on monkeys until the method was successful enough to try on a man. "And I know of no better person," the writer earnestly went on, "than yourself for the first human experiment. If you will sit down and talk with me you will see that the idea is not nearly so fantastic as it sounds."

I think that would appeal to Slim more than any of the others!

THERE were not a few vague but palpably dishonest schemes for getting rich quick. One was "a brand-new counterfeiting device which is absolutely secret, Colonel Lindbergh, and will turn out real ten-dollar bills quicker than the eye can follow!"

An extraordinary number of letters offered help to Lindbergh. Many people apparently believed he would at once settle down, build a house, get married and have children. This meant he would need furniture, bank accounts, groceries, clothing, cradles, carpets, books, medicines, and goodness knows what. Thousands offered to supply him these articles at reasonable prices, in some cases free, provided he would let his name be used as a client of the manufacturer or retailer.

Thus his mass of parcel post included every sort of article from safety razors to spare tires, most of which were sent with the hope he would endorse them. There were many gifts, too; such as cakes, hats, jewelry, handkerchiefs, ties and candy.

A number of private gymnasiums and physical instructors wrote eloquently about the strain he would be under and suggested courses of exercises, some free, some at varying costs.

It would take volumes to tell all that I saw in Lindbergh's mail. The things I have outlined briefly here represent merely a cross section of what will long be the greatest postal wonder in modern times, the finest example of mass appreciation of a great feat by a splendid youth.

What Do We Talk About?

WHAT we talk about was made the object of a recent psychological study by Dr. Carney Landis, of Wesleyan University. Standing for many hours on street corners in New York, Columbus, O., and London, England, he listened in on hundreds of conversations and carefully tabulated the results. Eavesdropping for science's sake, he heard two hundred talks in London alone.

American men, he finds, talk among themselves chiefly about money and business; American women, about men, clothing, themselves, and other women.

English men and women do much the same. But there is this difference—that while an American man talks sports or shop to a woman, the Englishman converses about women, clothes, or himself. In short, the Englishman adapts his conversation to the woman, while the American woman interests herself in the man's affairs, and he encourages her to do so.

Conversation in London, Dr. Landis finds, is in general more varied than that of America's streets.

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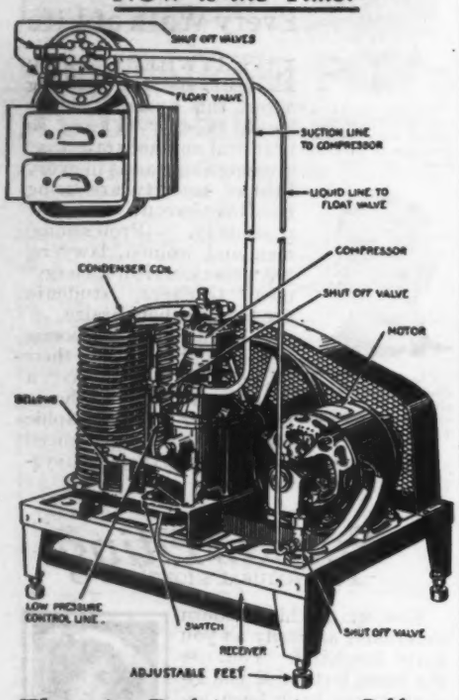

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Back-Seat Driving Real Peril

(Continued from page 69)

car really does require the undivided attention of the party doing the job. Something may happen any second. Suppose, for instance, you are bowling along on a straight, wide road and no cars or crossroads in sight—a pretty rare combination in these days of crowded roads!"

"That's the kind of a trip you dream about," Joe interrupted with a grin.

"It is," agreed Gus, "but just look at the number of things that can happen. Suppose your head is turned halfway round to catch a remark by someone on the back seat. At that particular instant a front tire decides to blow out. Maybe you'll get your attention back in time to keep the car from plunging into the ditch and maybe you won't.

"THEN there's always a chance of a car coming out of a side road that you didn't see, or perhaps a kid on a bicycle. What chance would you have?

"According to the nerve experts, it takes the average man about a tenth of a second to react to any kind of a stimulus. That means that at least a tenth of a second goes by between the instant your eyes tell you that you ought to put on the brakes and the instant when your foot starts pushing on the brake pedal. If you're only going thirty miles an hour, the car travels nearly nine feet during the time that it takes you to realize that you should put on the brake, and it goes a few feet more before you get the brake on.

"With a handicap like that you can't afford to let your attention be diverted while you're driving."

"Maybe you're right, on paper at least," Joe commented somewhat sarcastically, "but you can't make me believe that every fellow that's driving a car ought to sit there with his hands gripping the wheel like grim death and his eyes glued to the road. What fun would there be in driving?"

"You don't get me at all," Gus replied. "I didn't mean anything of the kind. But the driver ought to consider driving his main job—keep that thought in the front of his head at all times. Of course if he can talk to the other passengers, kind of casual like, with the part of his brain that isn't concentrated on driving, there's no harm done, but if it distracts his mind at all he certainly ought to cut it out."

"Seems to me that drivers ought to keep their feet on the pedals all the time," Joe suggested.

"SOUNDS good," replied Gus, "but you can't do it unless you operate the throttle by means of the control on the steering wheel. You can't very well have your foot on the accelerator pedal and the brake pedal at the same time and if you keep your foot on the brake pedal and work the throttle by hand the chances are you will get into trouble unless you're mighty familiar with that way of doing things. In a sudden emergency you are likely to jam on the brake without closing the throttle and the drive shaft or some other part may give way under the strain."

"Maybe you're right," Joe agreed. "And now that you've added mental treatment to your list of accomplishments, how about working up some way to throw a scare into my wife? She's developing back seat driving tendencies, too!"

Suggestive of the mythical unicorn of early tradition, a four-footed creature with a single spiked horn, was a freak deer recently observed at Yosemite Valley National Park, in Yosemite, Calif. Otherwise like a normal deer, this young buck had a single curious horn projecting through the roof of its upper jaw halfway between its nose and eyes.

Do You Make these Mistakes in ENGLISH?

Sherwin Cody

MANY persons say "Did you hear from him today?" They should say "Have you heard from him today?" Some persons spell calendar "calender" or calander." Still others say, "between you and I" instead of "between you and me." It is astonishing how many persons use "who" for "whom," and mispronounce the simplest words. Few persons know whether to spell certain words with one or two "c's" or "m's" or "r's," or with "ie" or "ei," and when to use commas in order to make their meaning absolutely clear. Most persons use only common words—colorless, flat, ordinary. Their speech and their letters are lifeless, monotonous, humdrum. Every time they speak or write they show themselves lacking in the essential points of English.

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